THE ENGINEER

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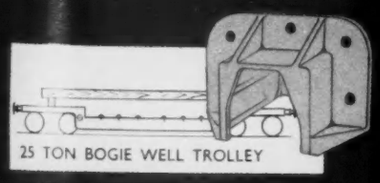

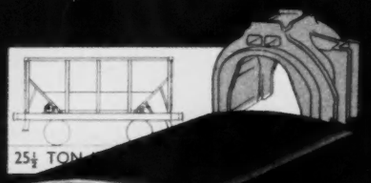

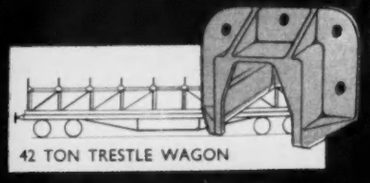

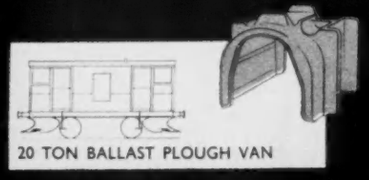

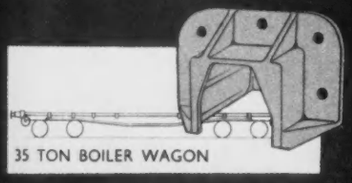

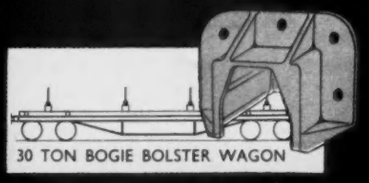

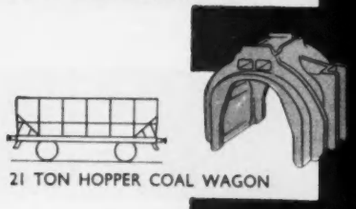

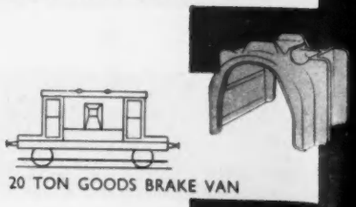

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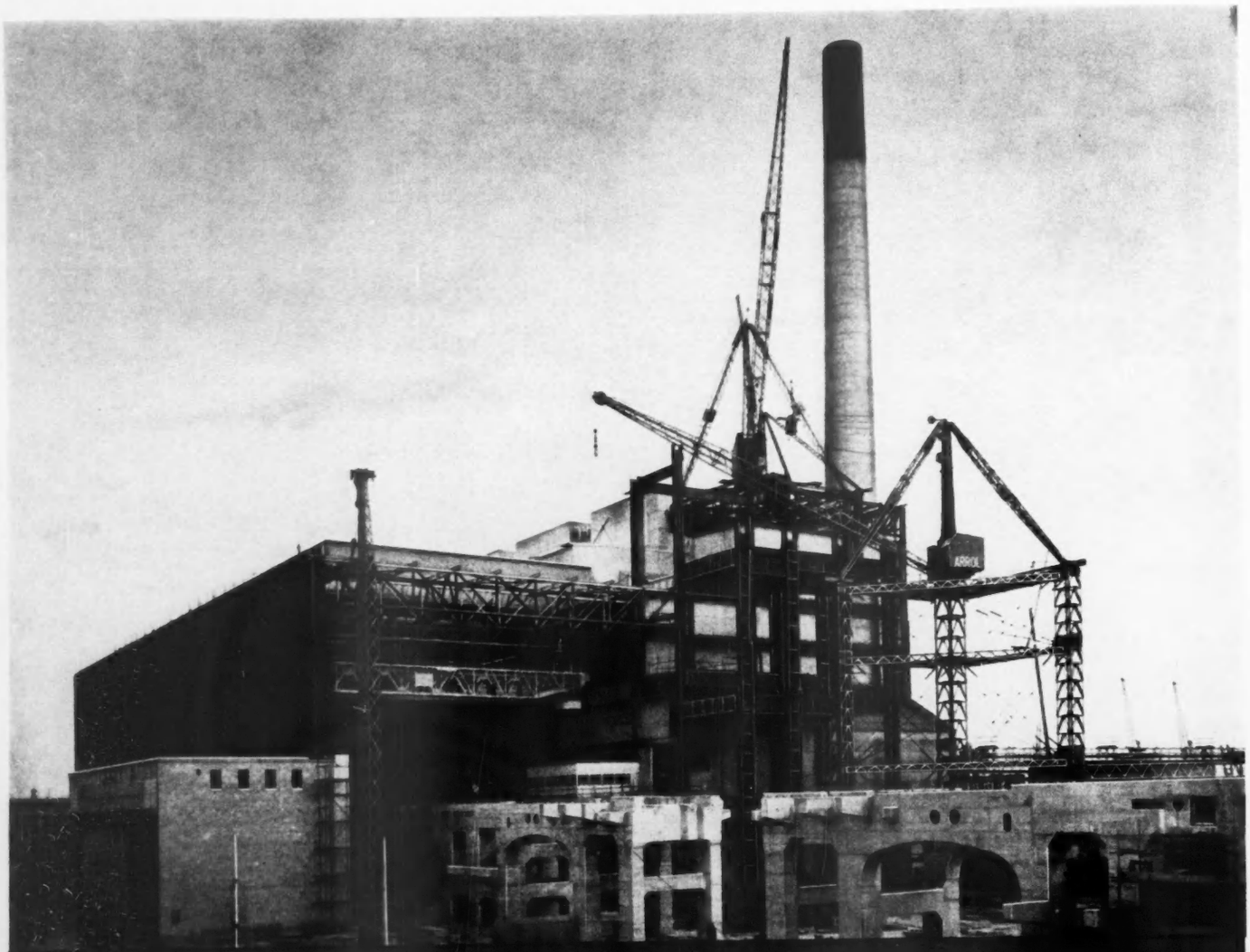

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THE ENGINEER

Established 1856

No. 5394 JUNE 12, 1959 VOL. 207

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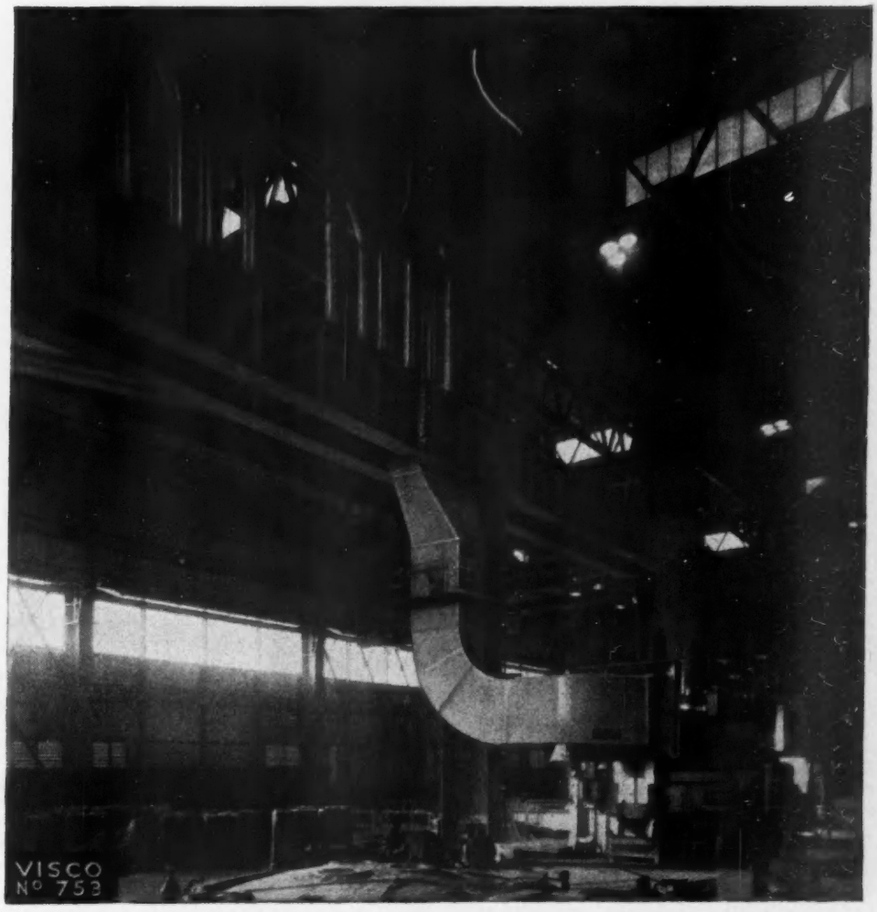

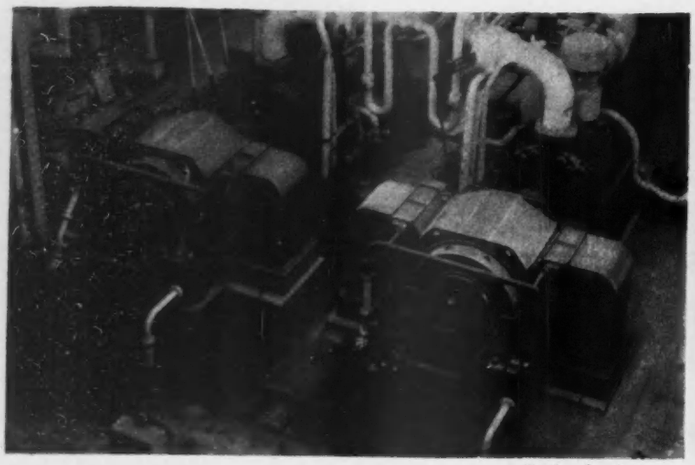

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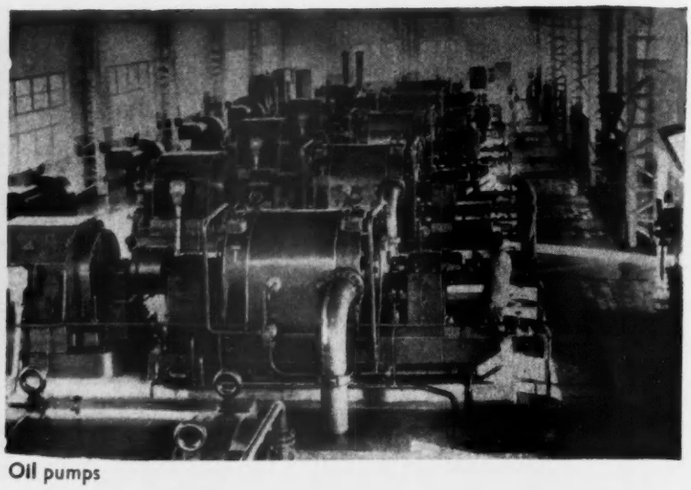
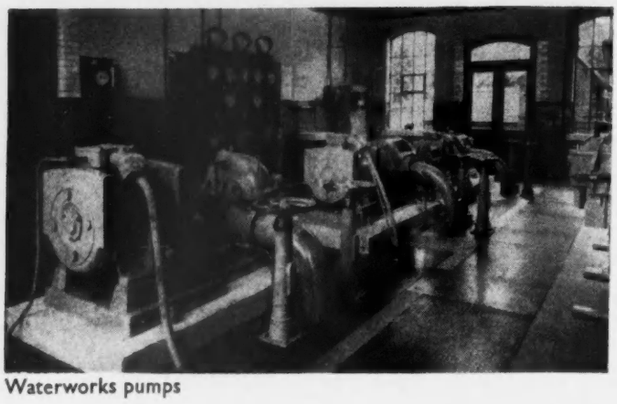
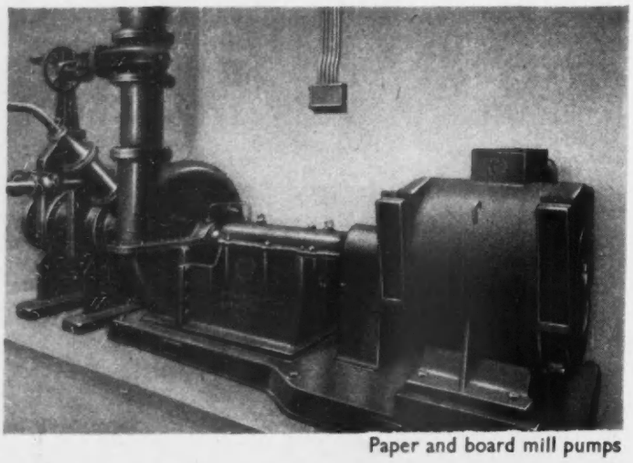


Oil pumps

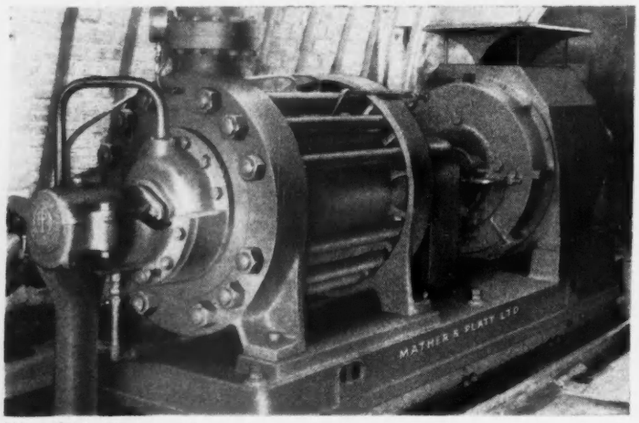
Pumping Sets



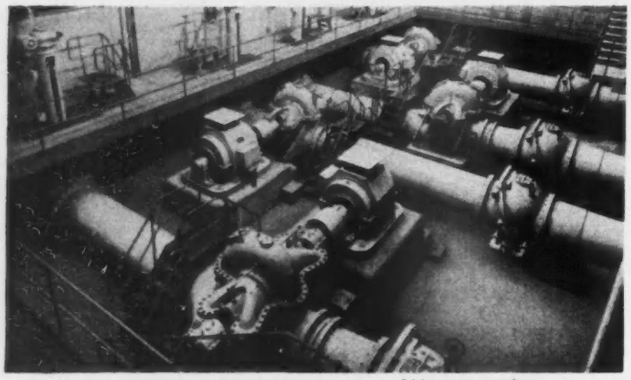
Waterworks pumps



Paper and board mill pumps



Mine drainage pumps



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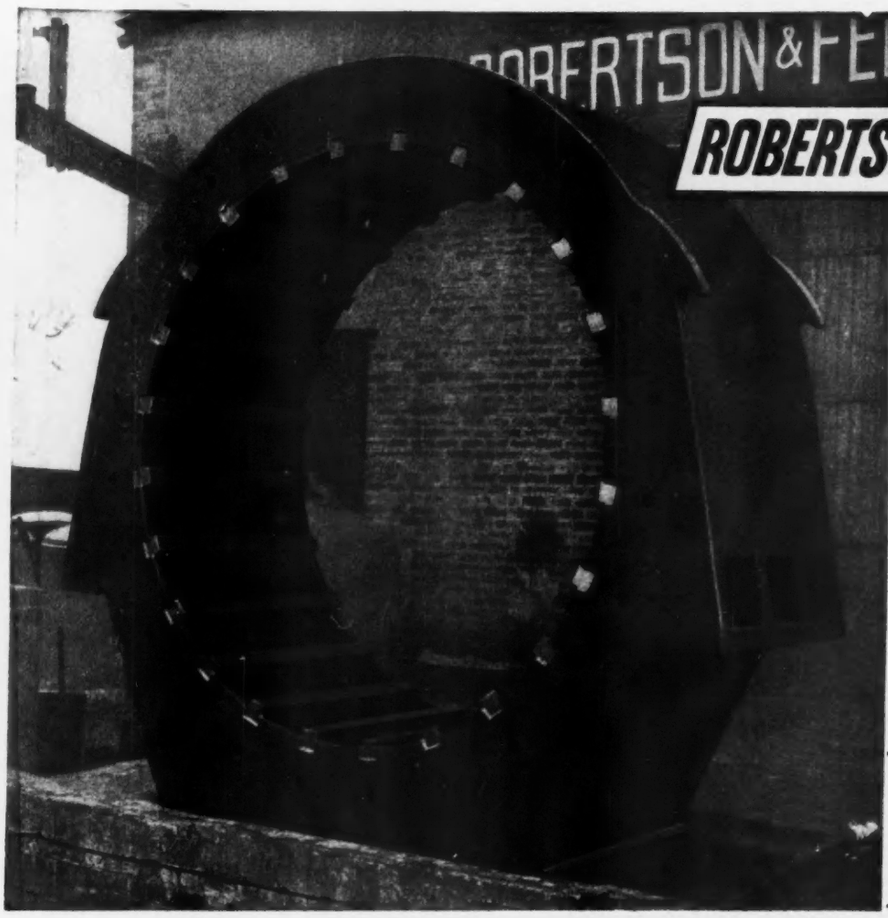

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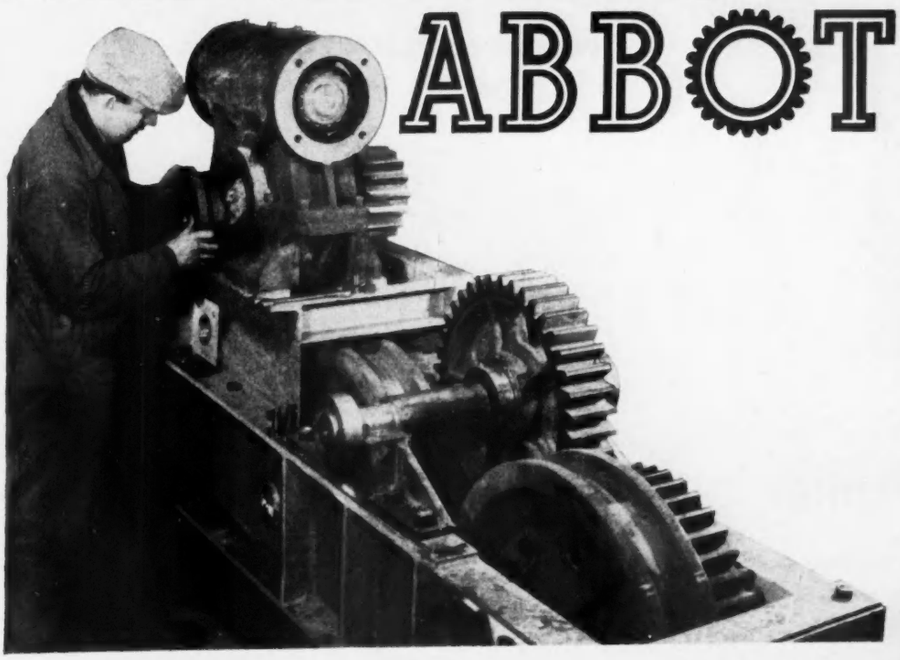

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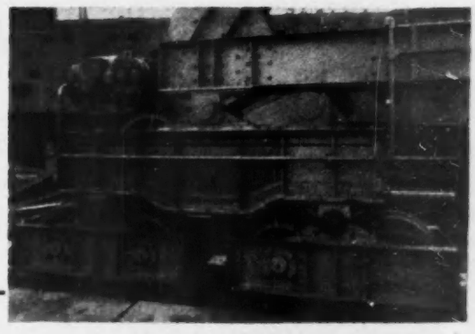

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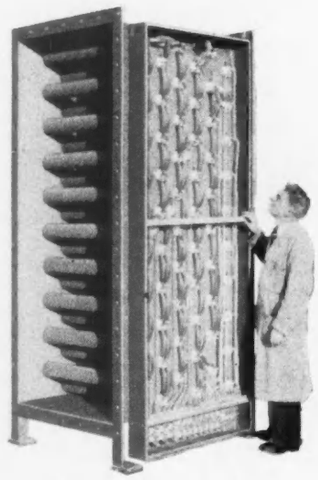

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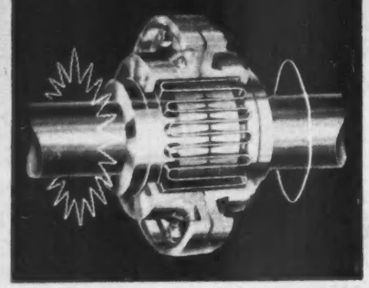

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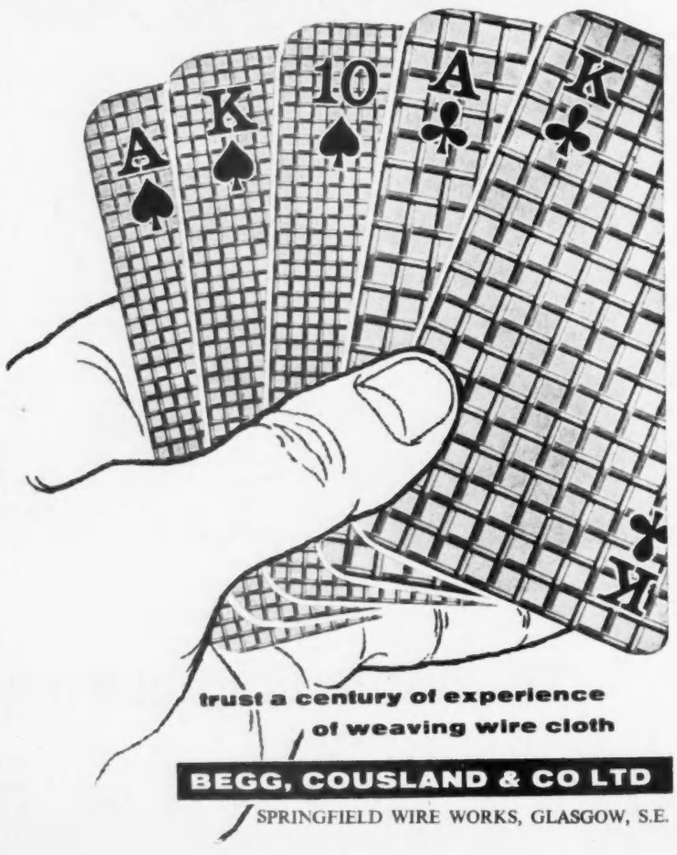

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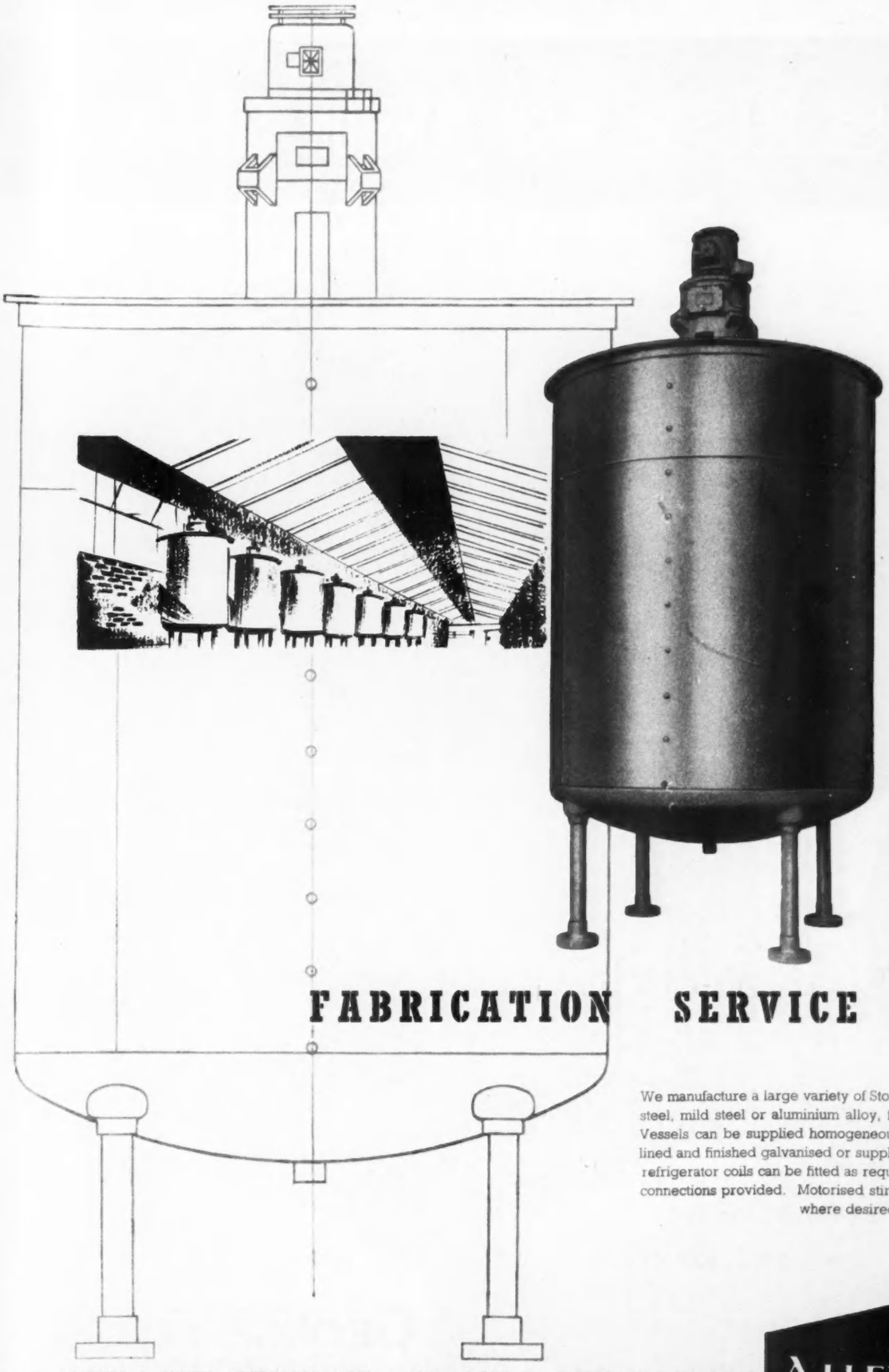

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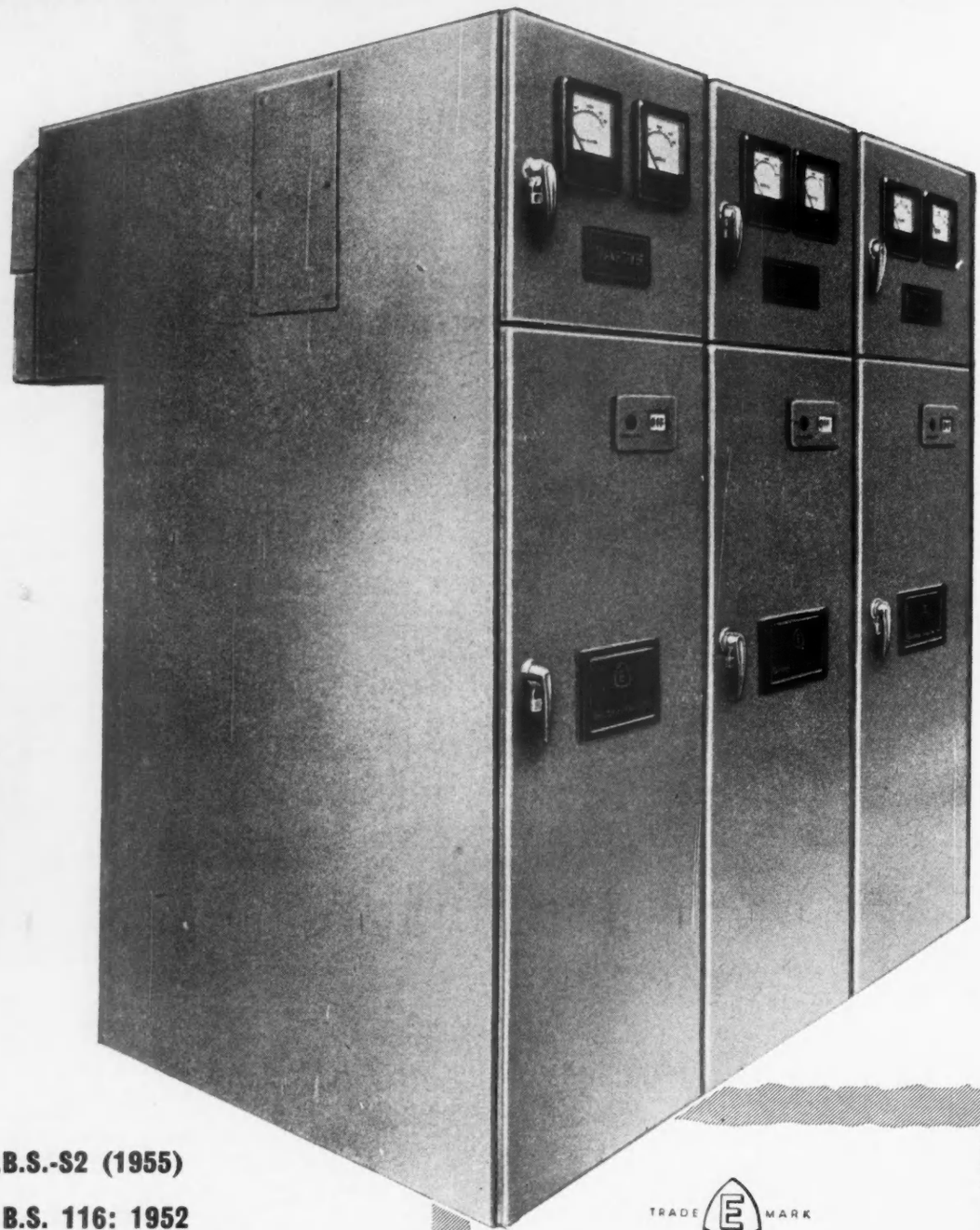

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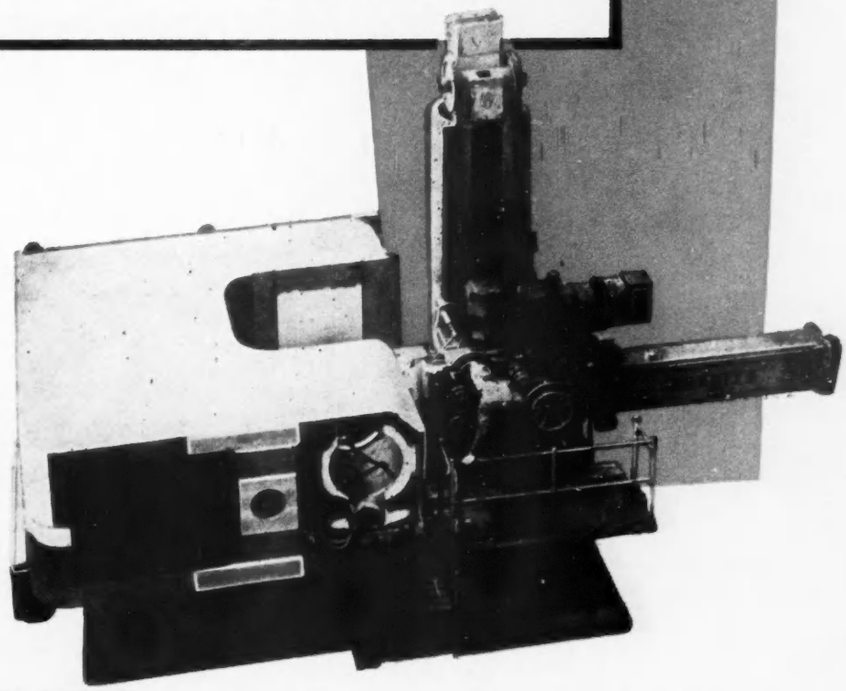

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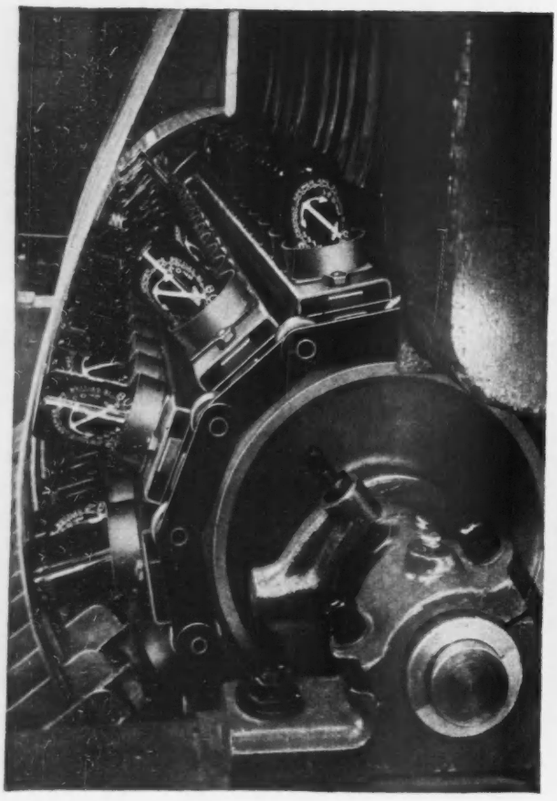

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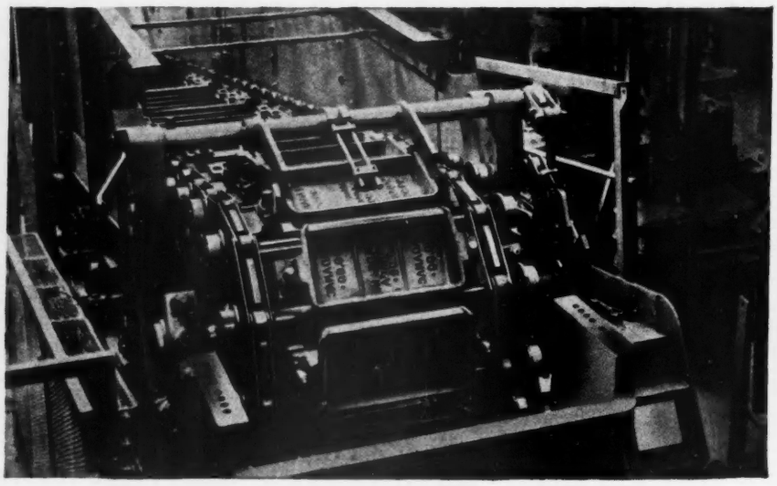

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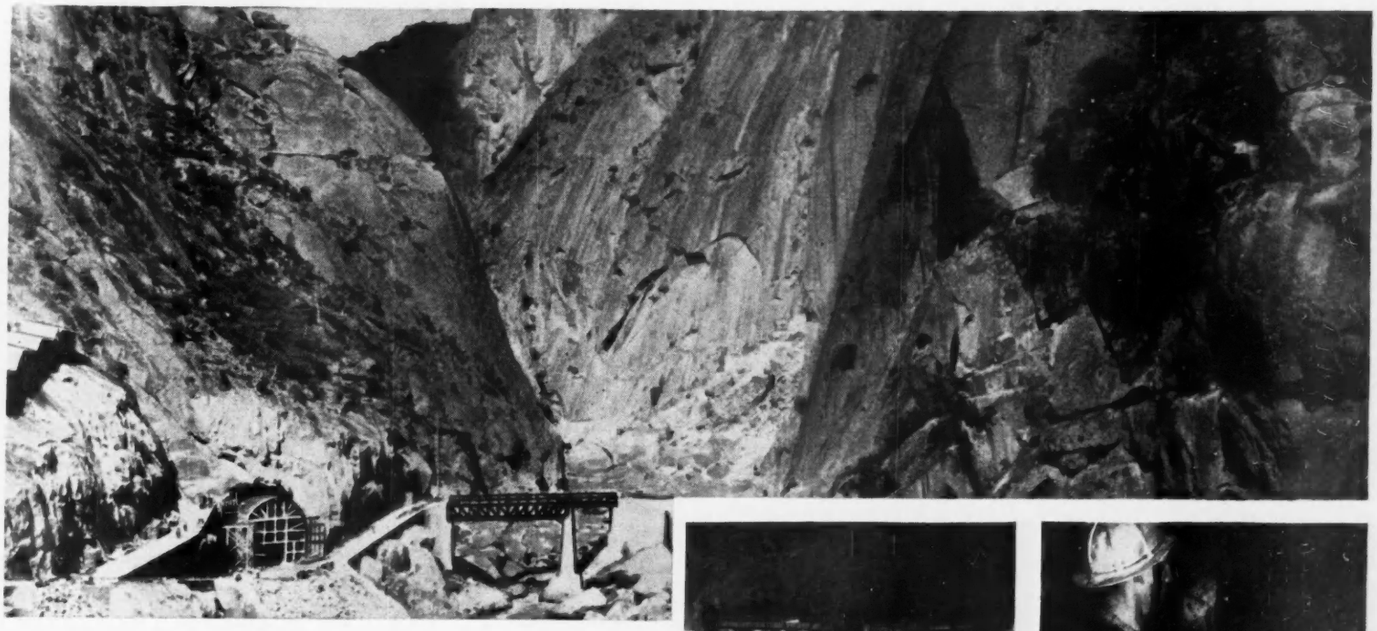

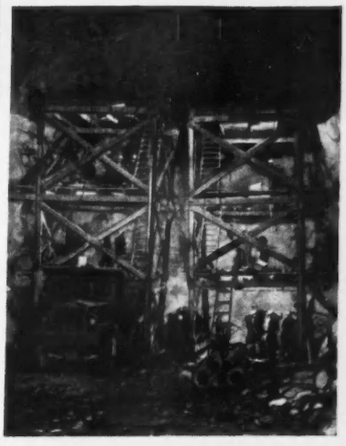

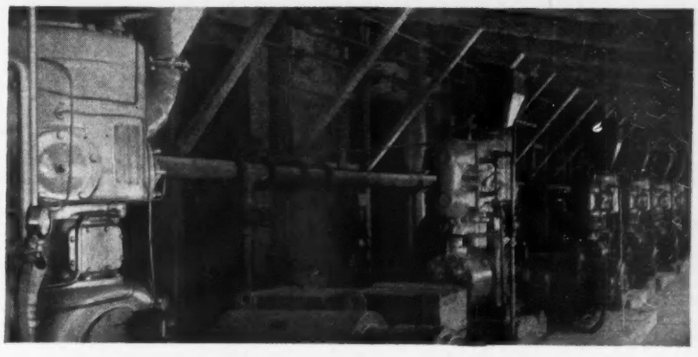

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ANNUAL OUTPUT — 1,700 MILLION kWh

The dam will form a reservoir for 150 million cu. yds. of water. The underground power station containing six units will have an installed power capacity of 762,000 kVA. Annual output of the project is estimated at 1,700 million kWh. This power station alone will give Spain a larger increase in installed capacity than the total national increase in hydro-electric energy during the period 1950-1954.

925,000 CU. YDS. OF ROCK TO BE EXCAVATED

All the rock drilling on the site is being done by 165 Atlas Copco rock drills using Sandvik Coromant drill steels. Tunnelling accounts for more than half of their excavation task which, in all, amounts to almost a million cu. yds. They are powered by a battery of 14 stationary compressors—types currently the leading choice for tunnelling projects throughout the world—the Atlas Copco AR3 and AR4.

MORE THAN 1,300 MILLION FEET DRILLED EVERY YEAR

Atlas Copco rock drills and Sandvik Coromant steels were developed to work together as a lightweight drilling unit. Responsible for drilling more than 1,300 million feet annually, this drilling combination is now the most widely used in the world.

A COMPLETE RANGE OF COMPRESSED AIR EQUIPMENT

Atlas Copco manufactures portable and stationary compressors, rock-drilling equipment, loaders, pneumatic tools and paint-spraying equipment. Sold and serviced by companies or agents in ninety countries throughout the world.

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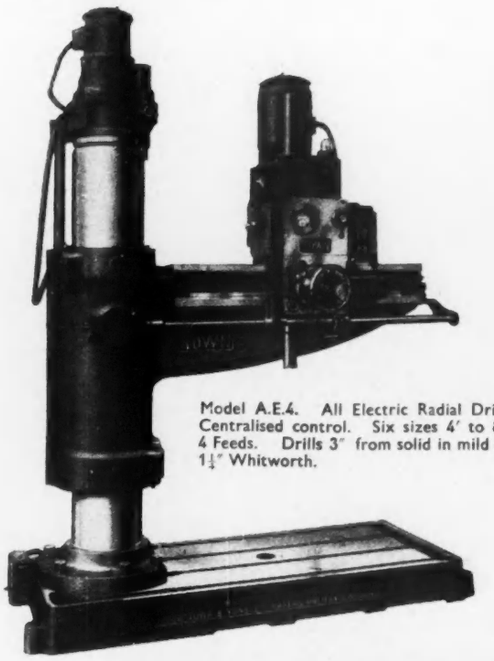
DBS 49

....almost everyone thought of them first

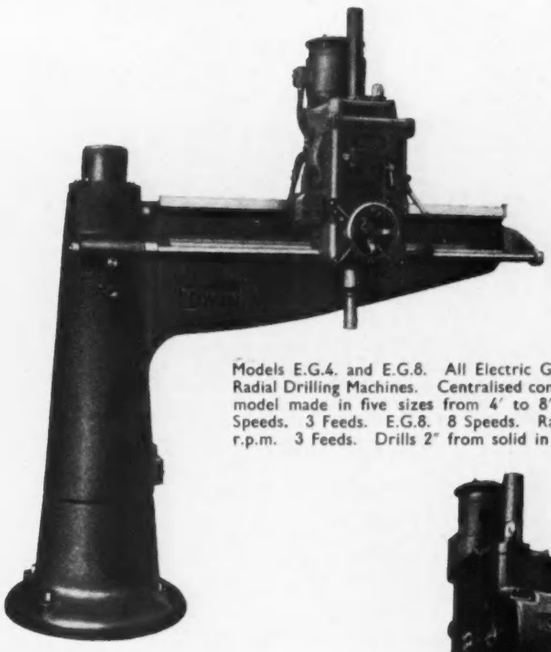
The Chinese invented everything from writing to rockets.... so they say. They may have pipped the ancient Egyptians; they certainly used them hundreds of years B.C.. The Romans knew about them and used them. As usual, the Greeks had a word for them. Even the Monks of the Middle Ages who discovered so many things may well lay claim to the invention of gears. But whoever thought of them first, lots of people make gears now. OPPERMANS OF NEWBURY FOR EXAMPLE. And as in everything else, some people make things better than others. OPPERMANS OF NEWBURY FOR EXAMPLE. Oppermans (of Newbury, you will remember) don't claim to have thought of gears first; but they think of little else now.

OPPERMANS OF NEWBURY

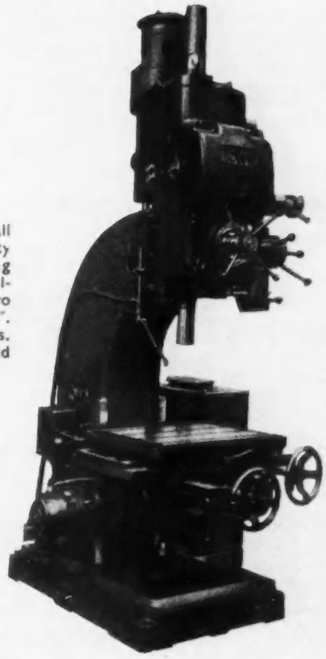
OPPERMAN GEARS LTD NEWBURY BERKSHIRE Telephone Newbury 1701 Telegrams Oppigears Newbury



Model A.E.4. All Electric Radial Drilling Machine. Centralised control. Six sizes 4′ to 8′. 12 Speeds. 4 Feeds. Drills 3″ from solid in mild steel and taps 1¼″ Whitworth.



Models E.G.4. and E.G.8. All Electric Girder Type Radial Drilling Machines. Centralised control. Each model made in five sizes from 4′ to 8′. E.G.4. 4 Speeds. 3 Feeds. E.G.8. 8 Speeds. Range 20-500 r.p.m. 3 Feeds. Drills 2″ from solid in mild steel.



Model A.E.2. All Electric Heavy Duty Vertical Drilling Machine. Centralised control. Two sizes 36″ and 42″. 18 Speeds. 8 Feeds. Drills 3½″ from solid in mild steel.

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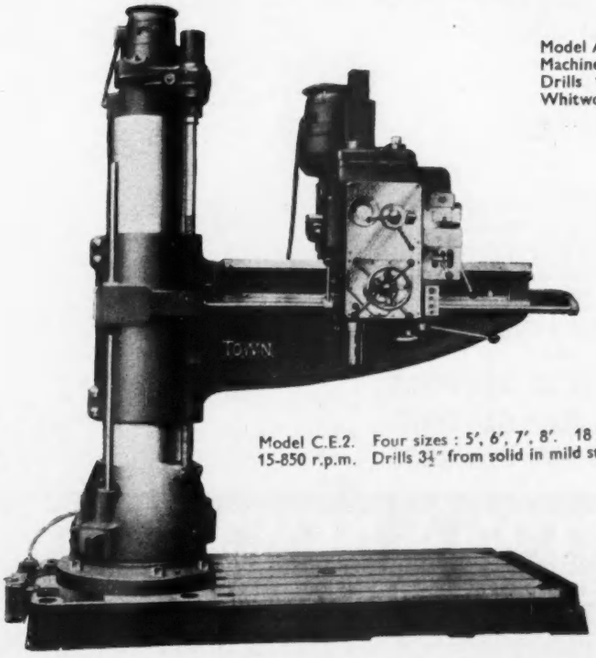
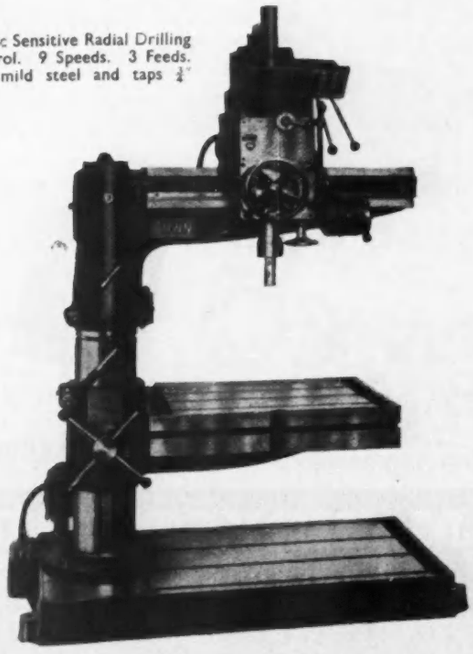


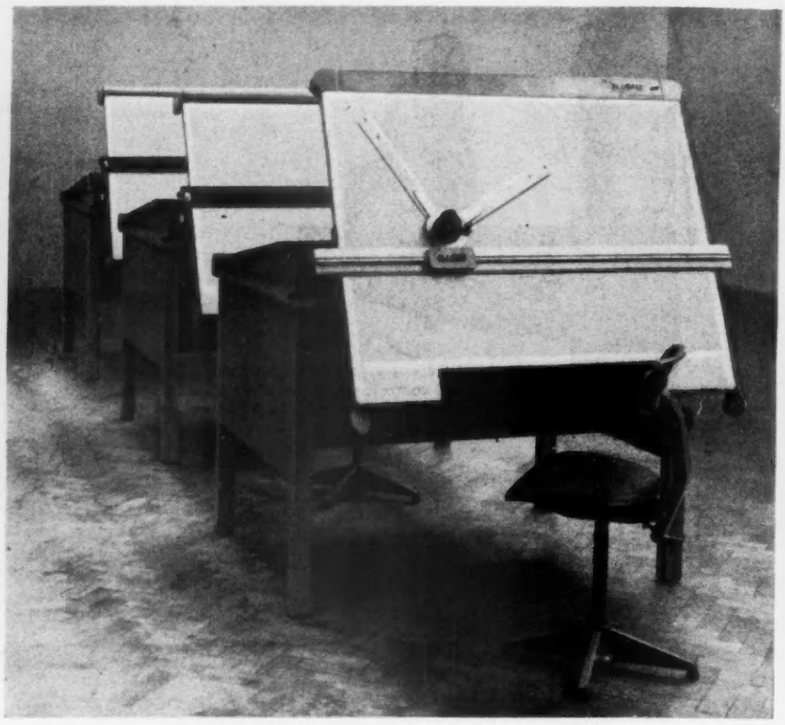
Model C.E.2. Four sizes : 5′, 6′, 7′, 8′. 18 Speeds : 15-850 r.p.m. Drills 3½″ from solid in mild steel.

Model A.E.5. 42″ All Electric Sensitive Radial Drilling Machine. Centralised control. 9 Speeds. 3 Feeds. Drills 1¼″ from solid in mild steel and taps ¾″ Whitworth.



T8
C

ARCLIGHT COMBINED DRAFTING REFERENCE UNITS



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The units in the illustration are shown fitted with drawing boards on Mason Minor Drafting Stands and with "Draftmaster" drafting machines.

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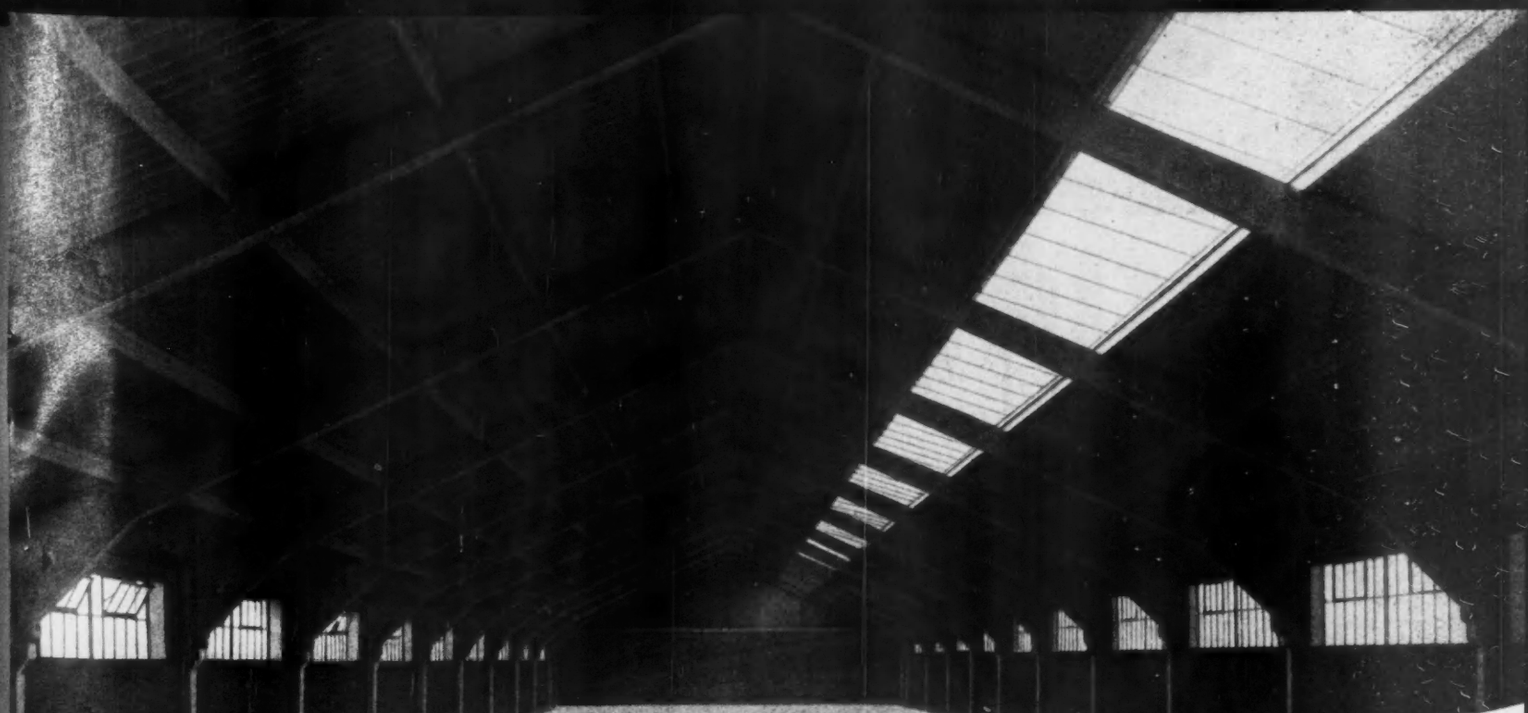

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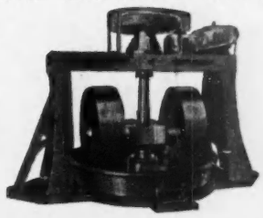

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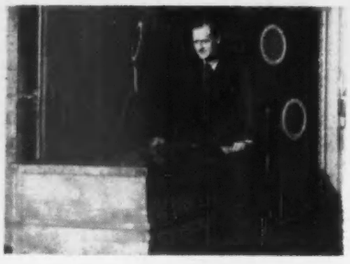

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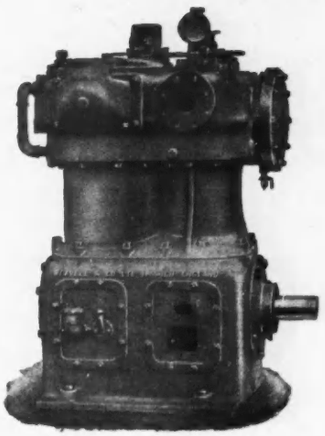

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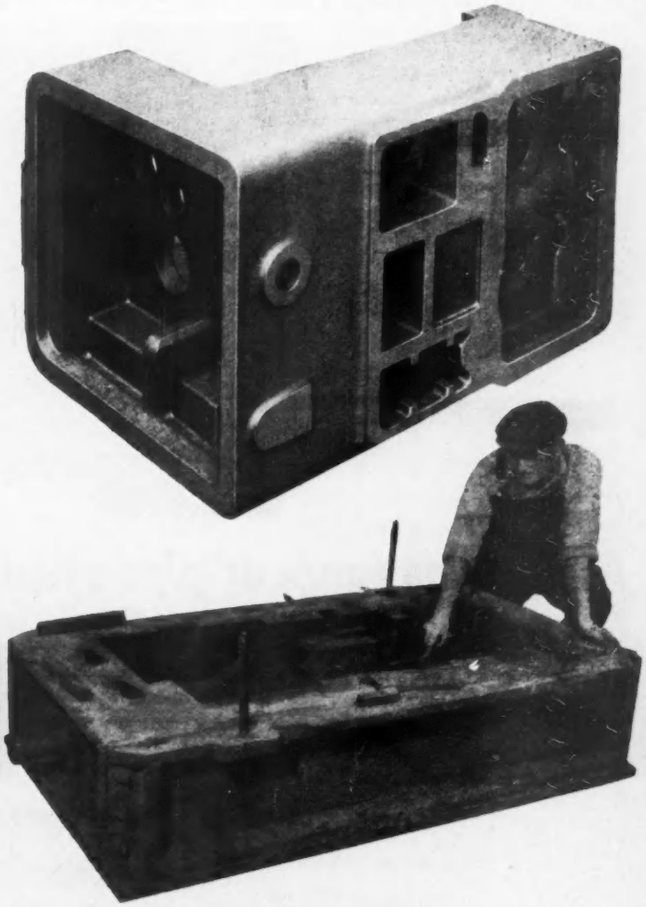

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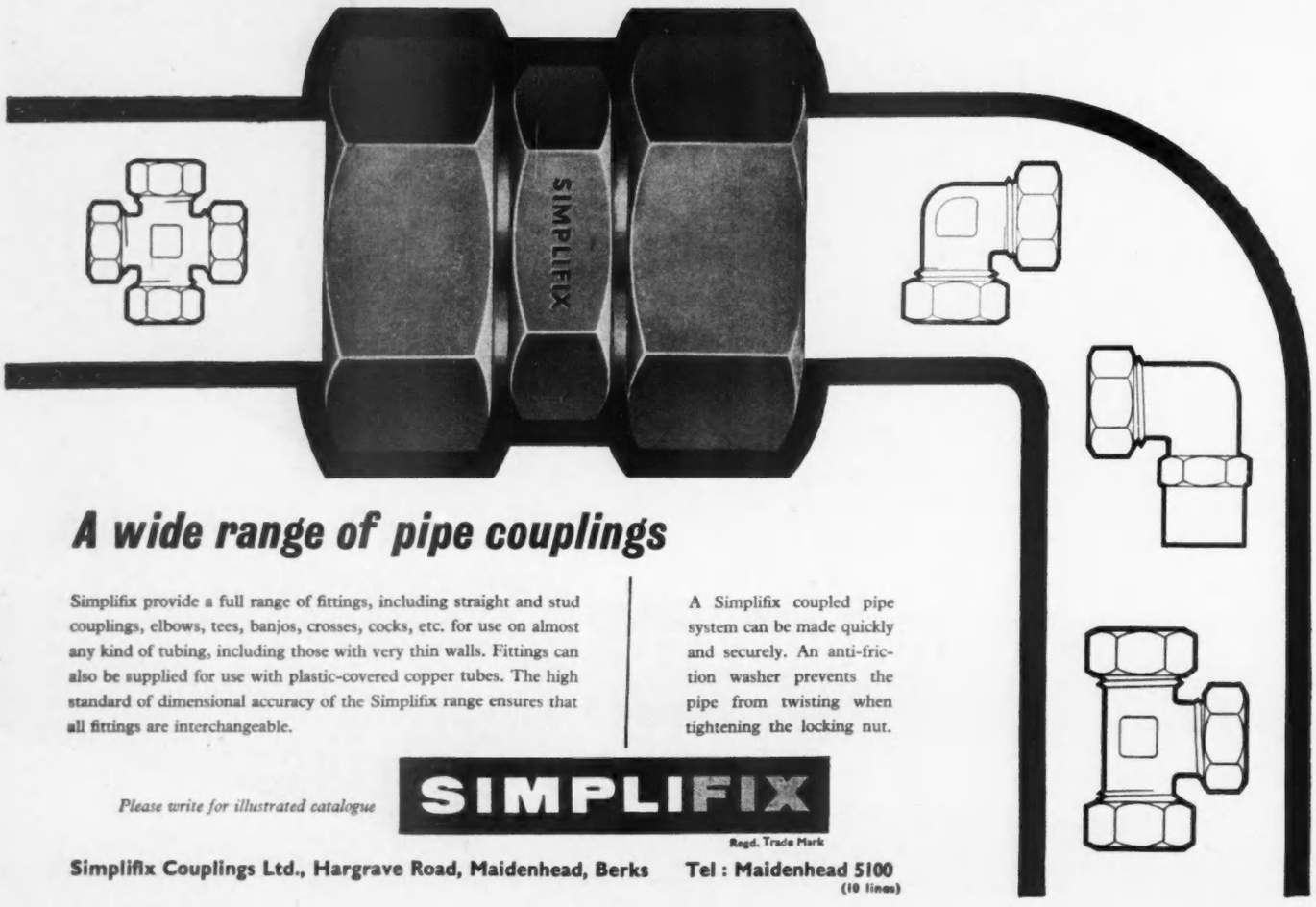

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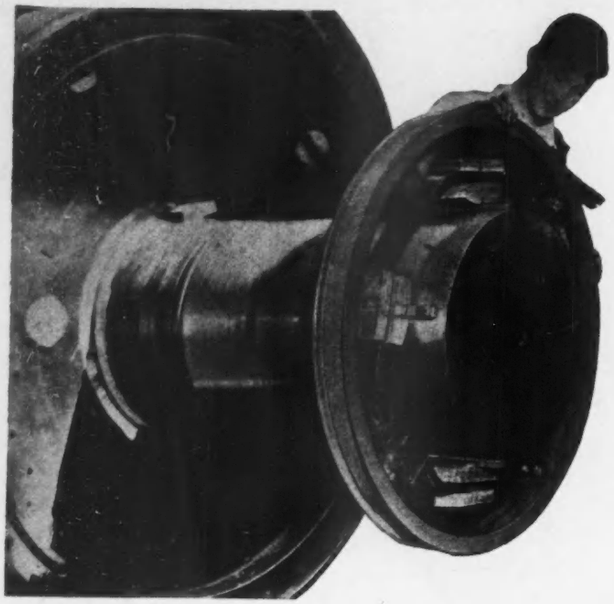

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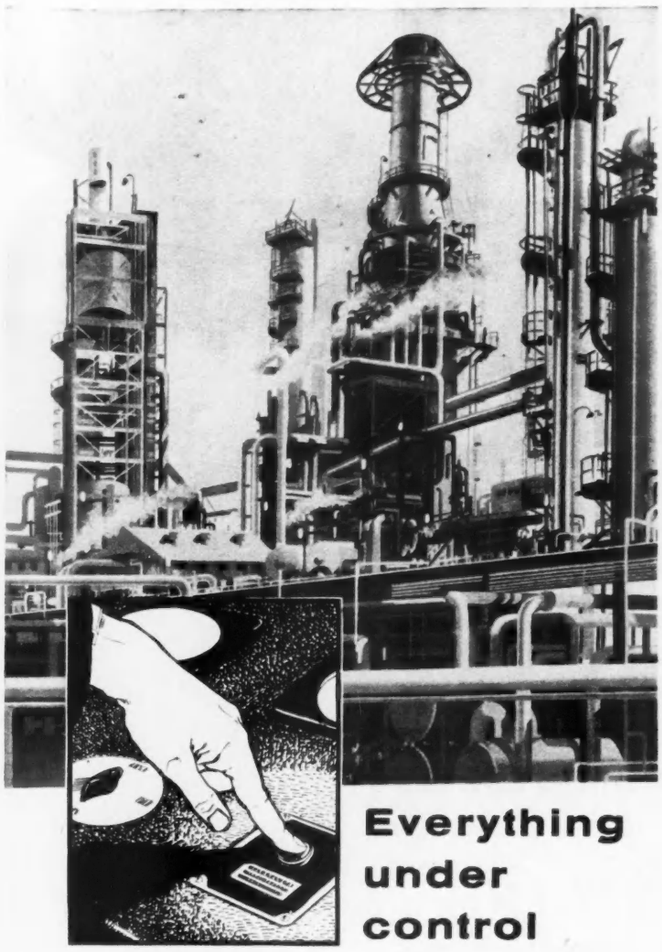

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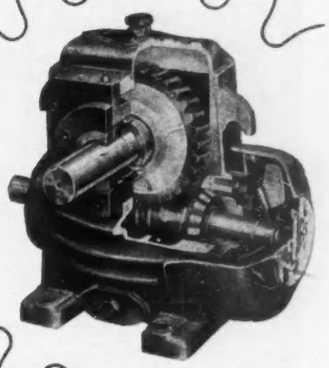

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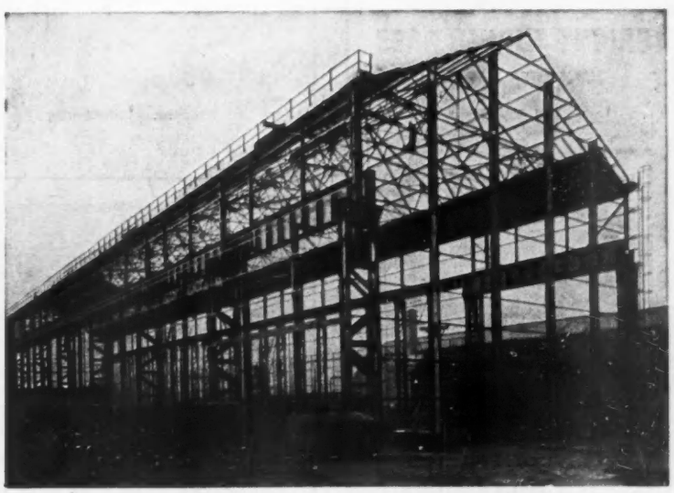

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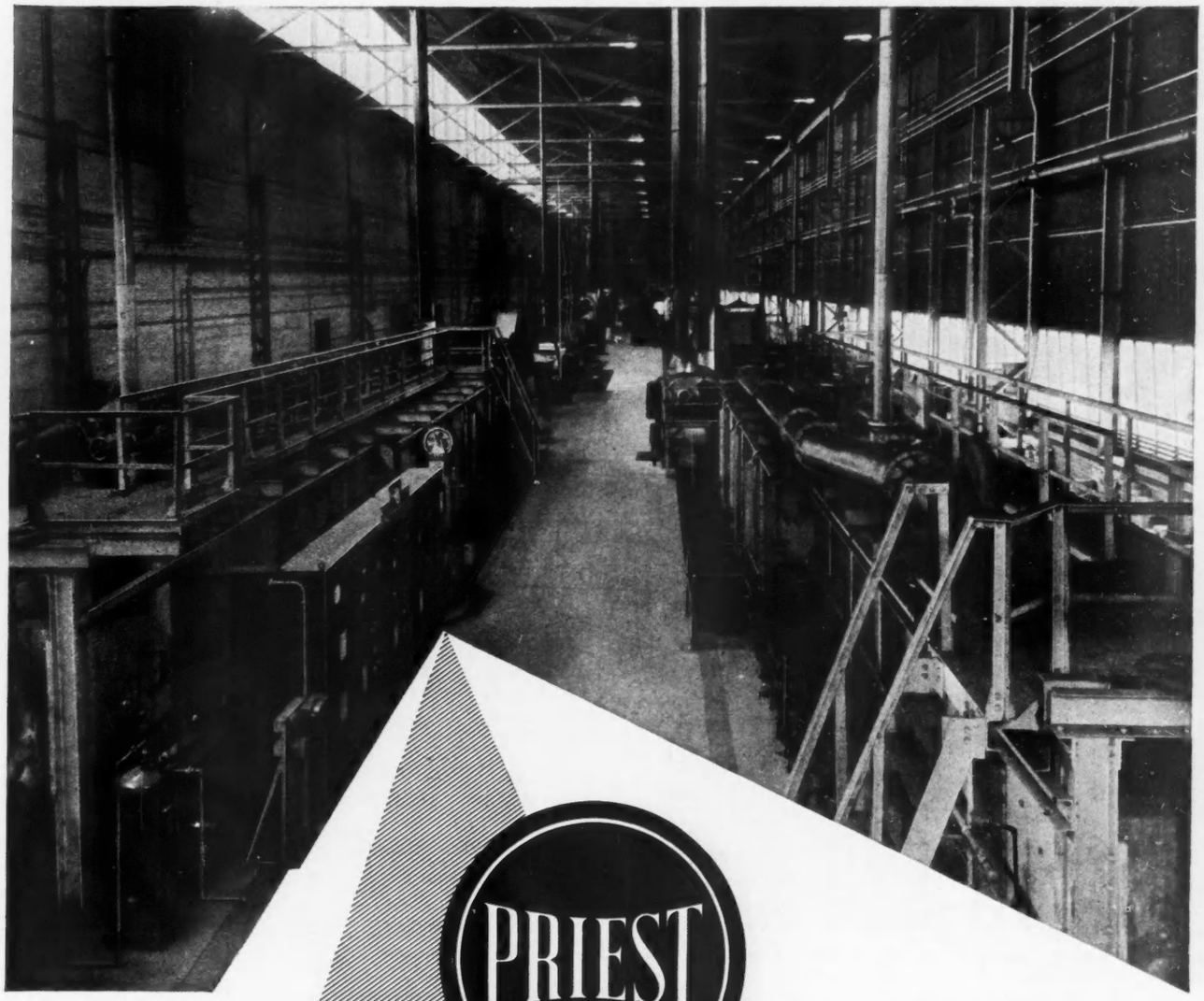

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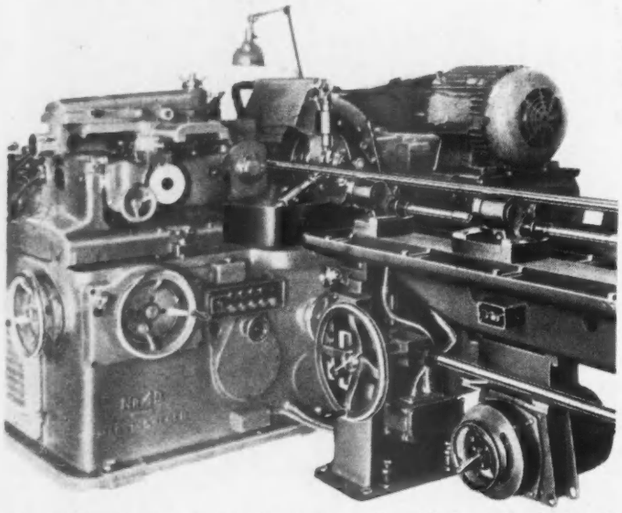

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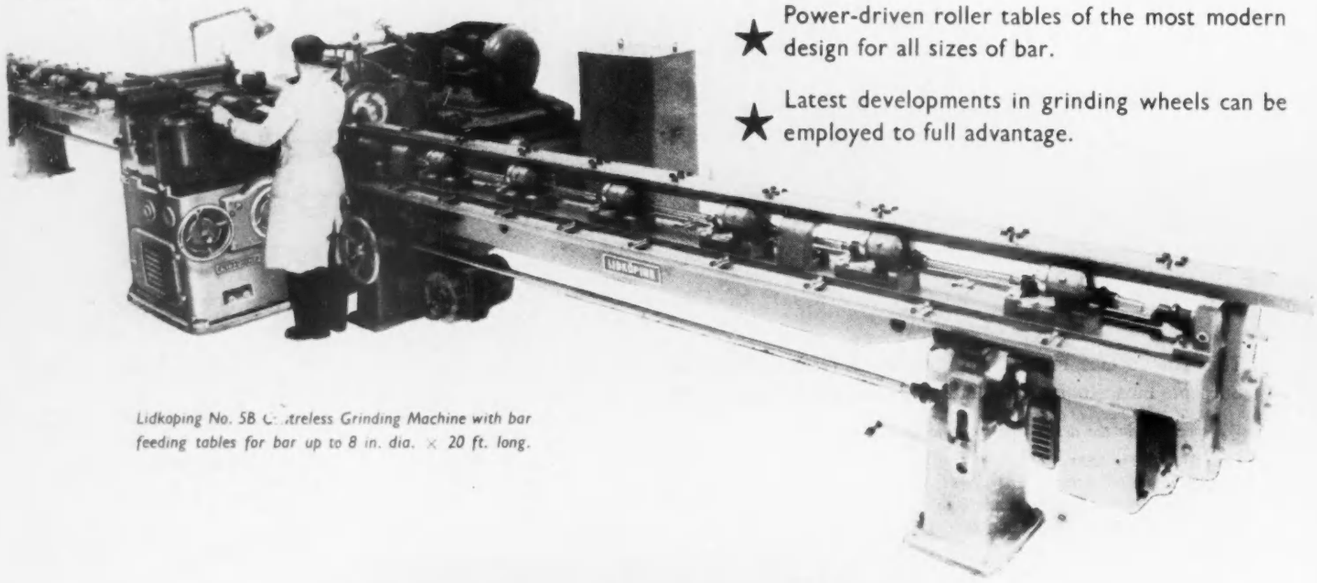

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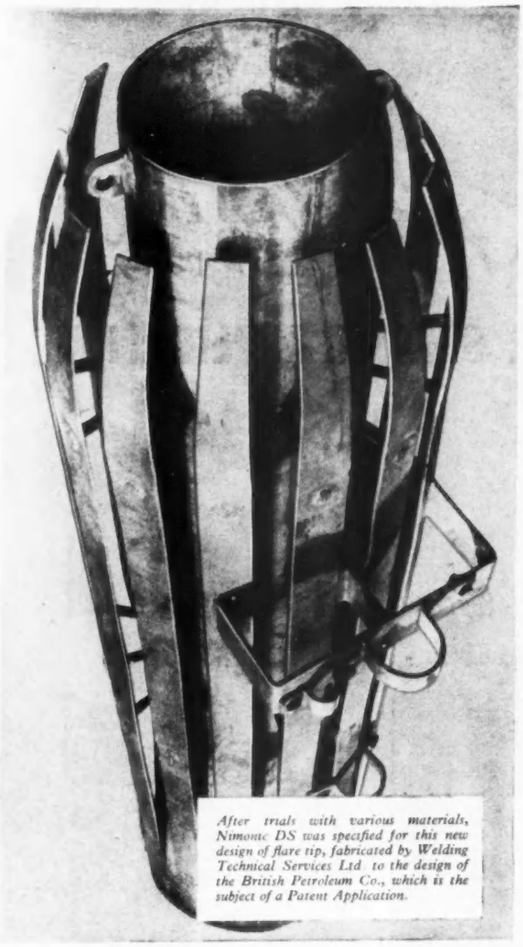

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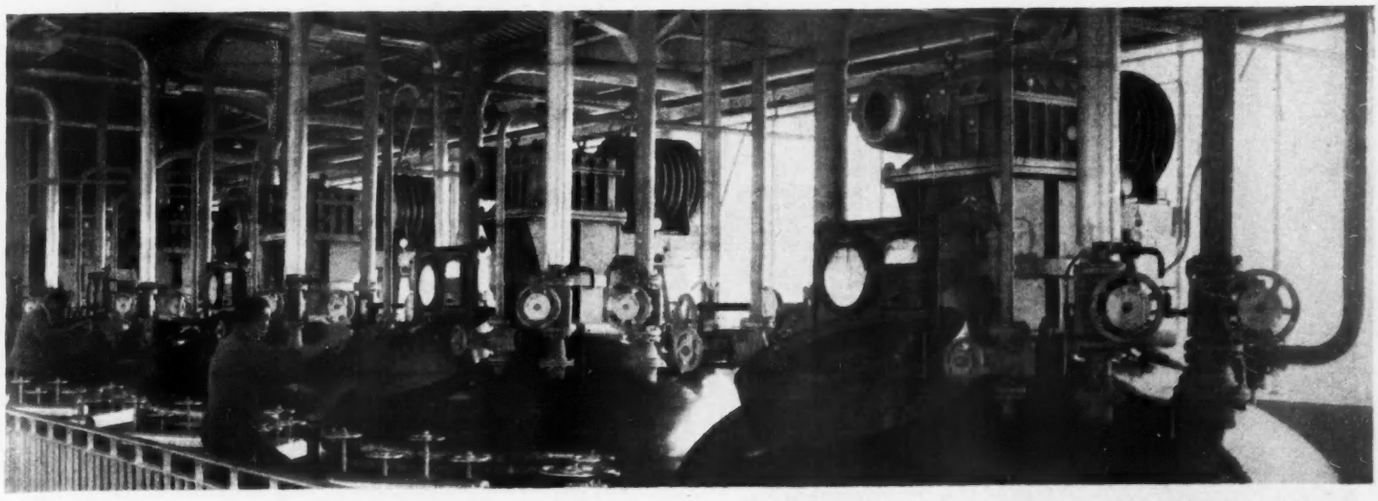

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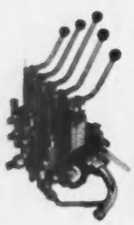

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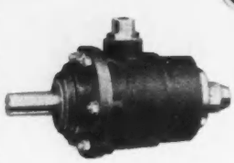

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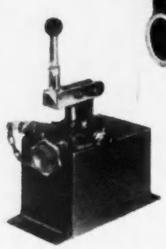

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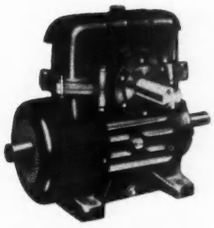

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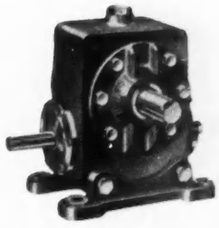

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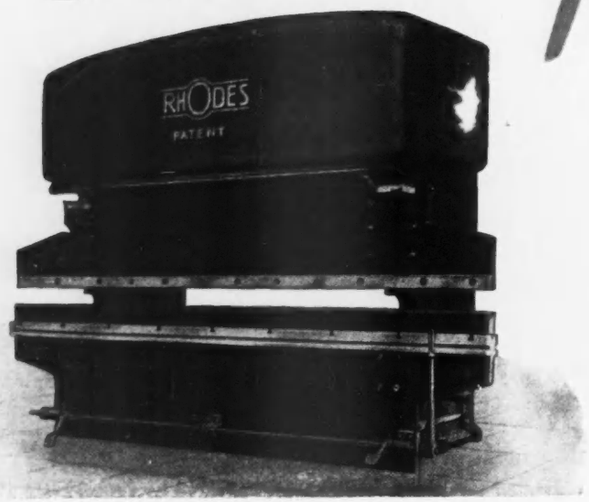

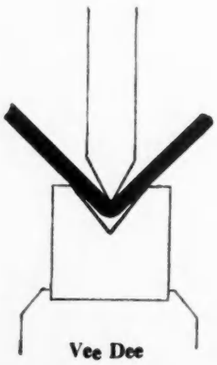
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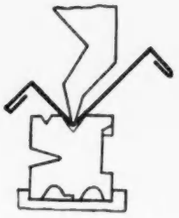

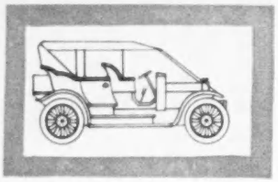

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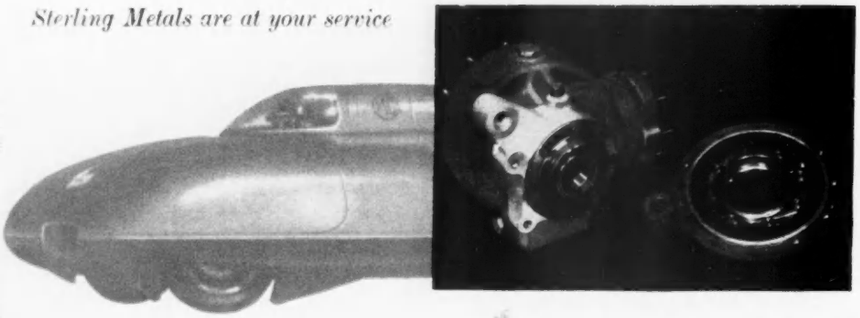

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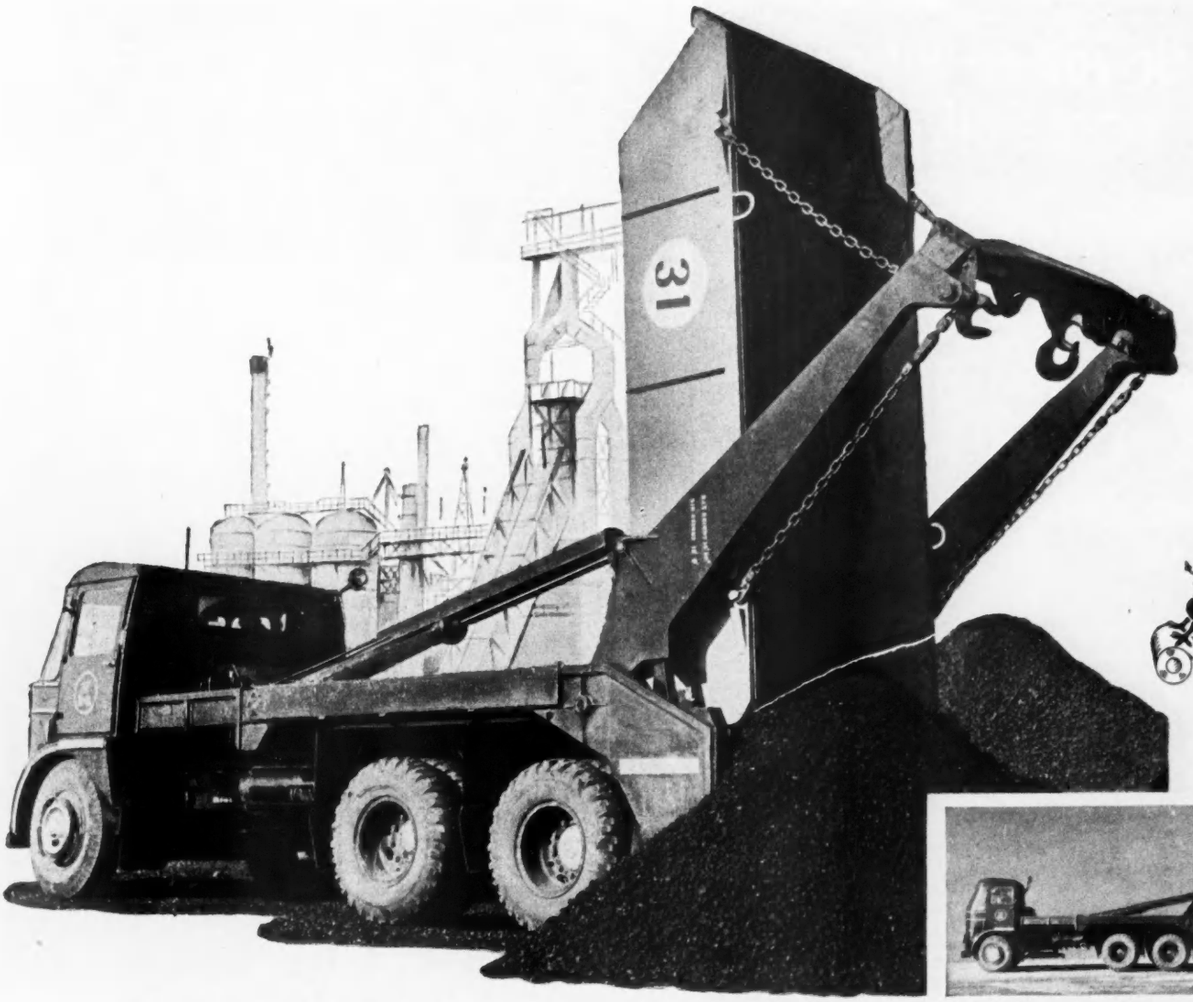

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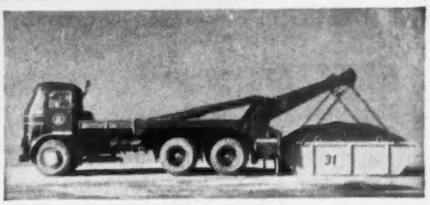
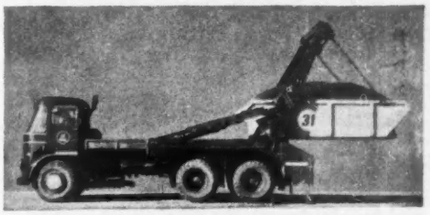
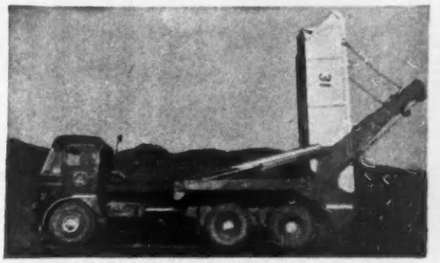


Rear independent hydraulic stabilizer jacks down. Load to be raised to Unit Deck.



Showing load being raised by retraction of hydraulically operated lifting arm rams.

Hydraulically operated rams fully retracted. Load located on Unit Deck. Jacks retracted.



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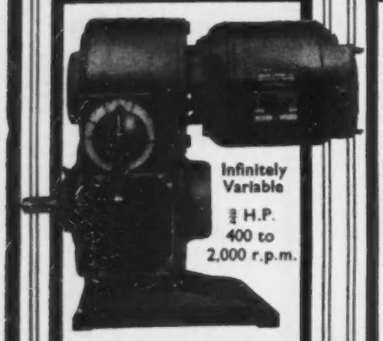

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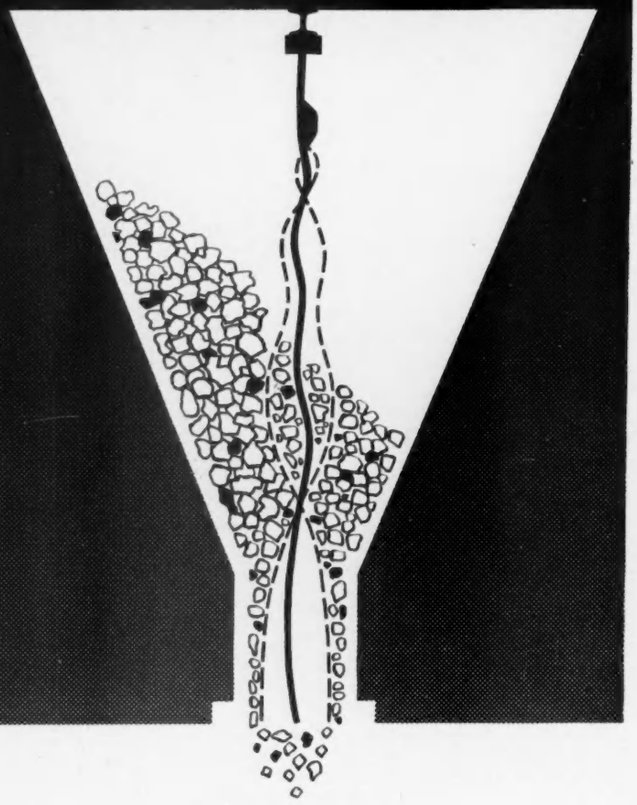

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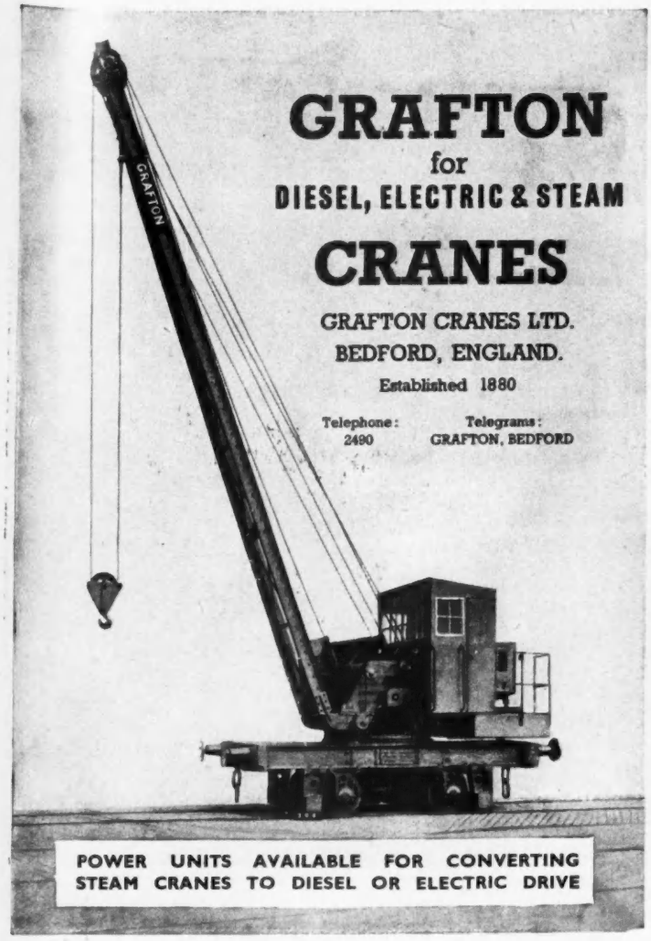

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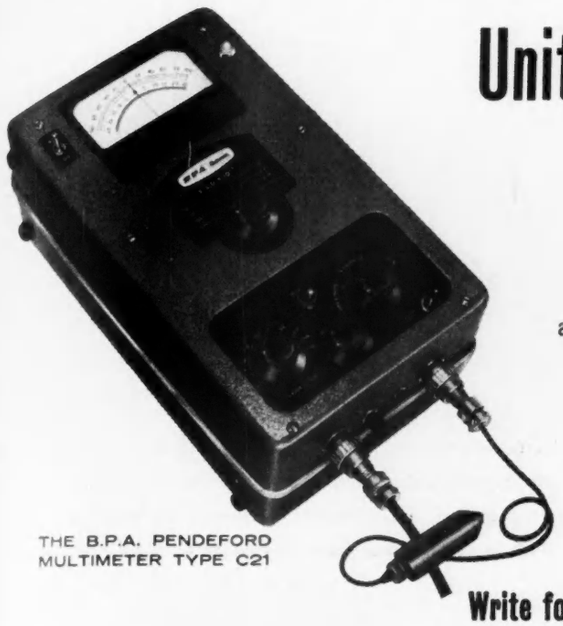

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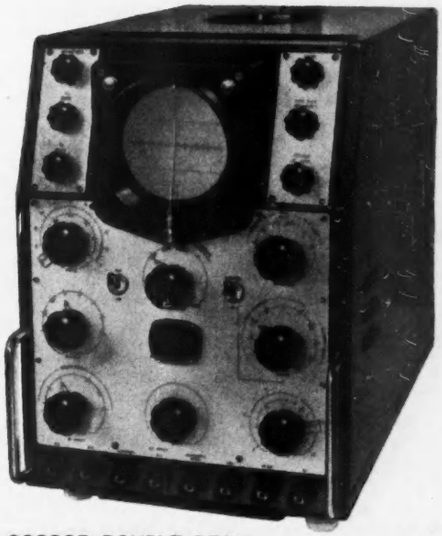

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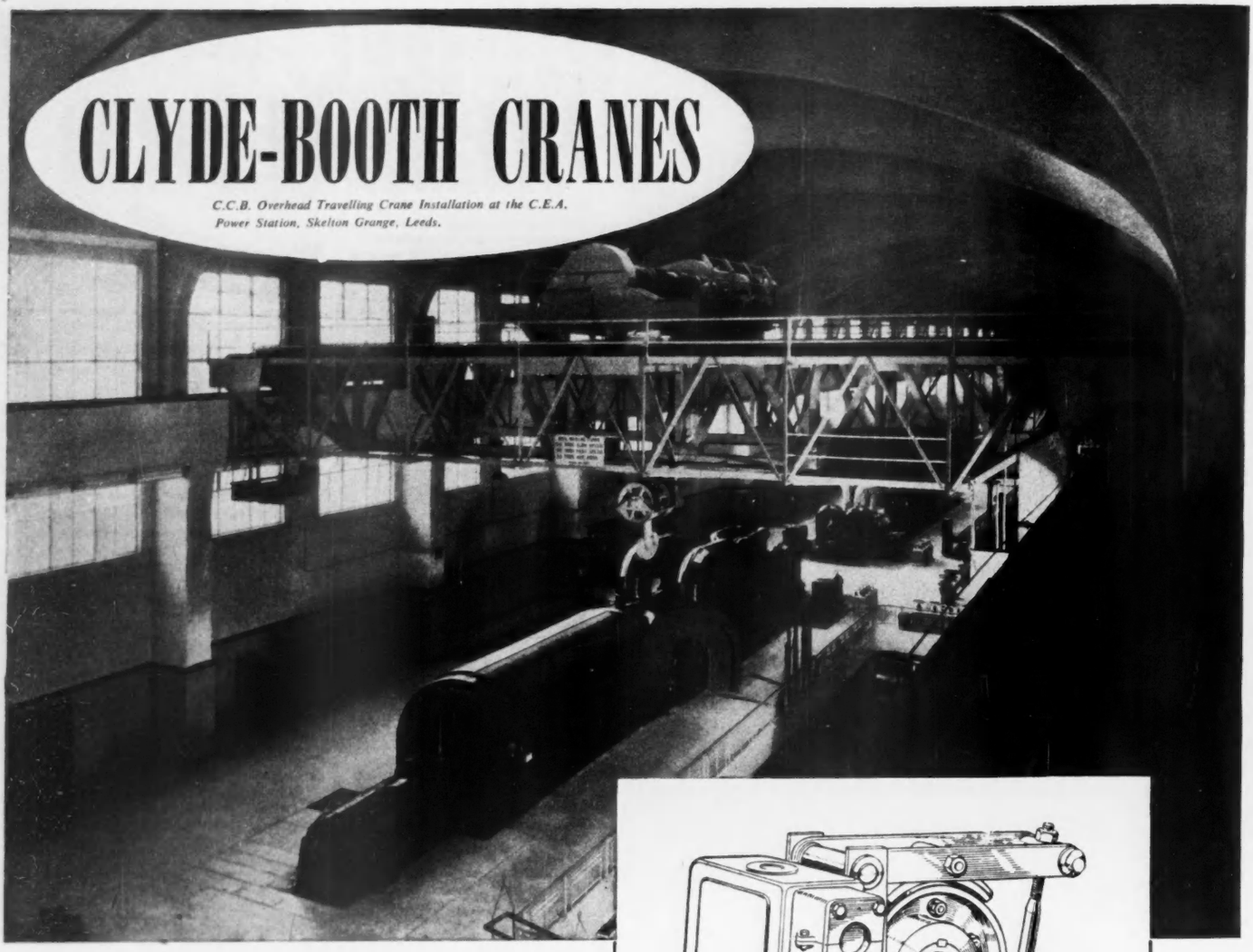

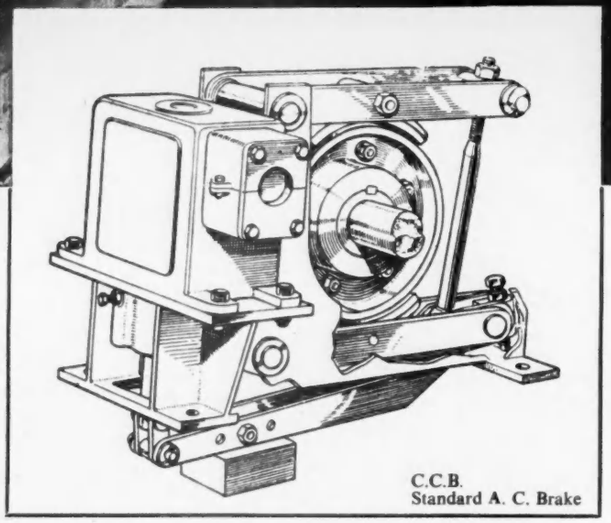

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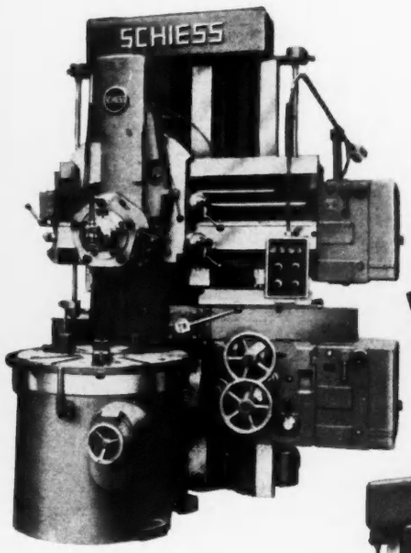
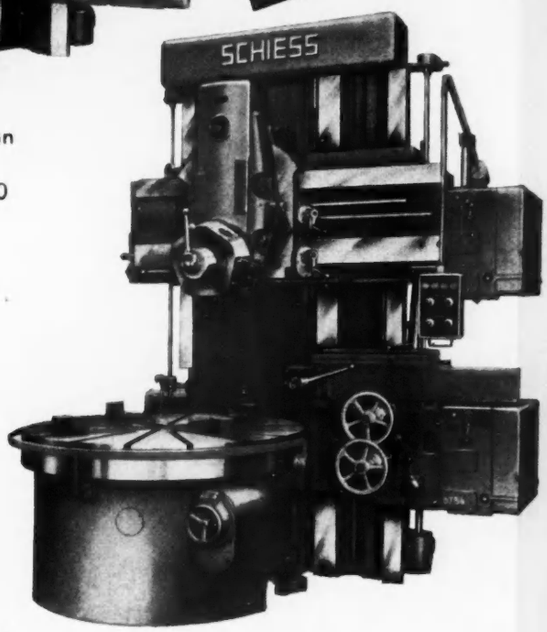
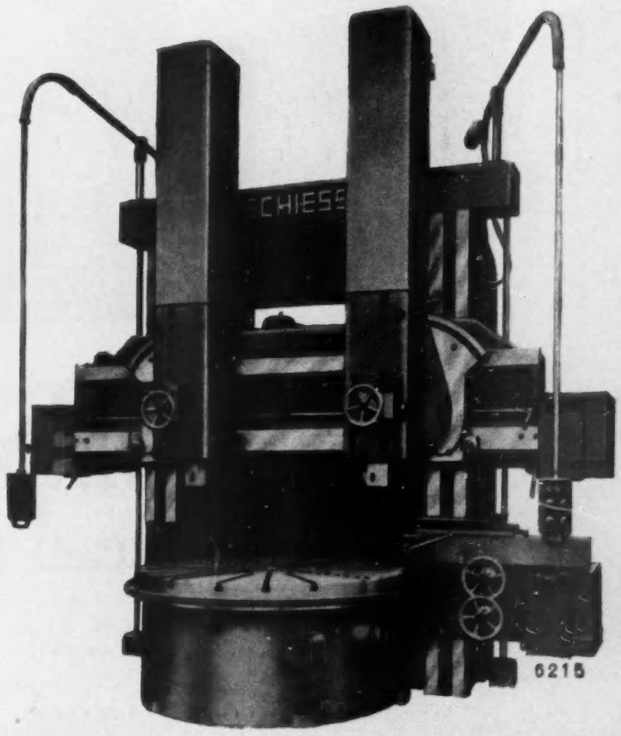
Specification			
Type	KE 100	KE 125	KE 160
Max. Turning Diameter / Table Diameter ins.			
Max. Turning Diam… with Side H…		16	16
Table r.p.m.	6.2-310	4.7-237	3.8-191
…mber of Horizontal and Vertical Feeds	12	12	12
Range of Feeds per Revolution of Table ins.	.0026 – .26	.0026 – .26	.0026 – .26



Single Column Boring Mill Model KE 100



Single Column Boring Mill Model KE 160



Double Column Boring Mill Model K Z 200

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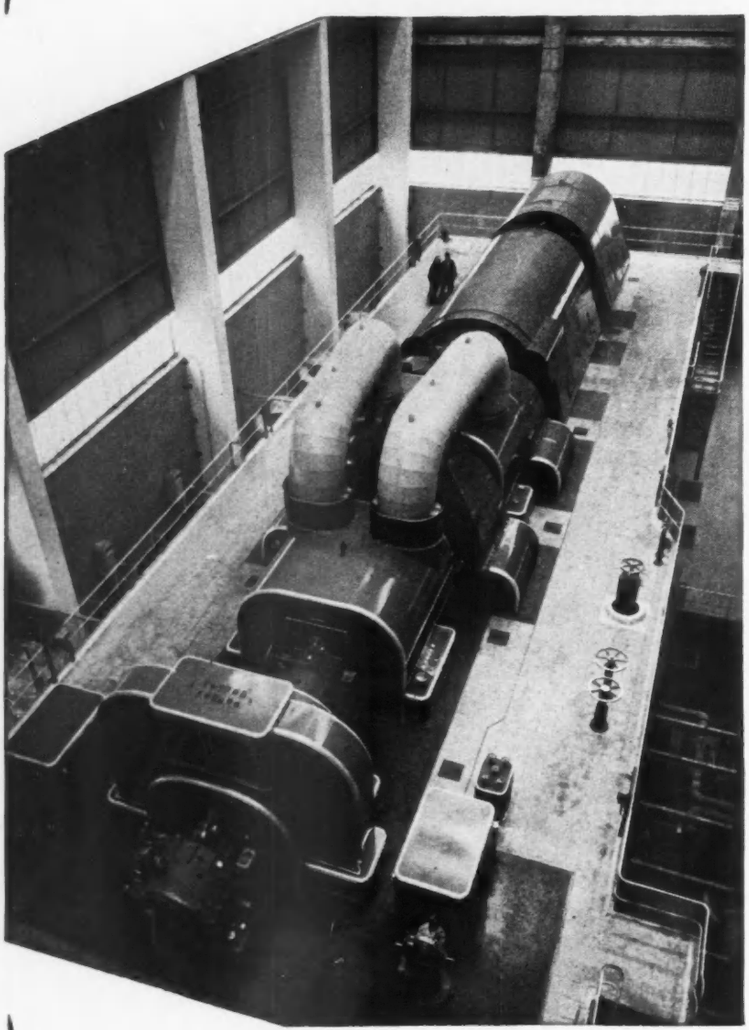

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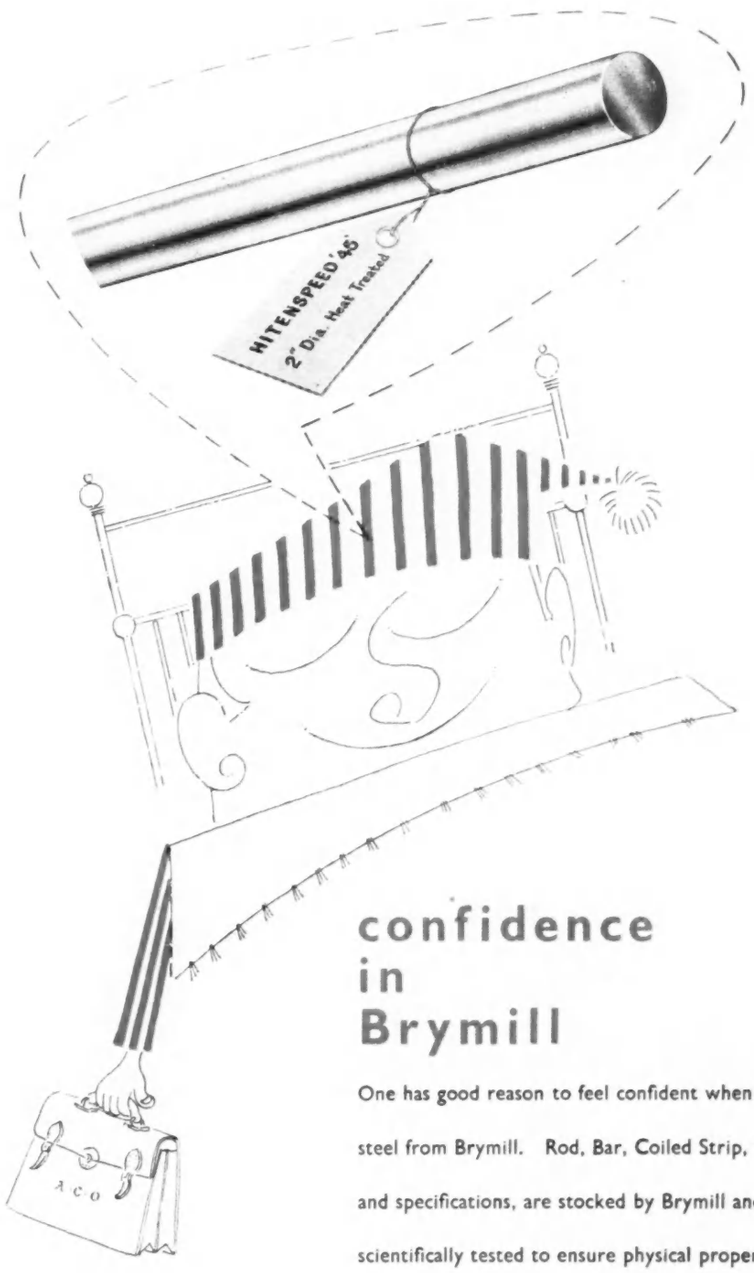

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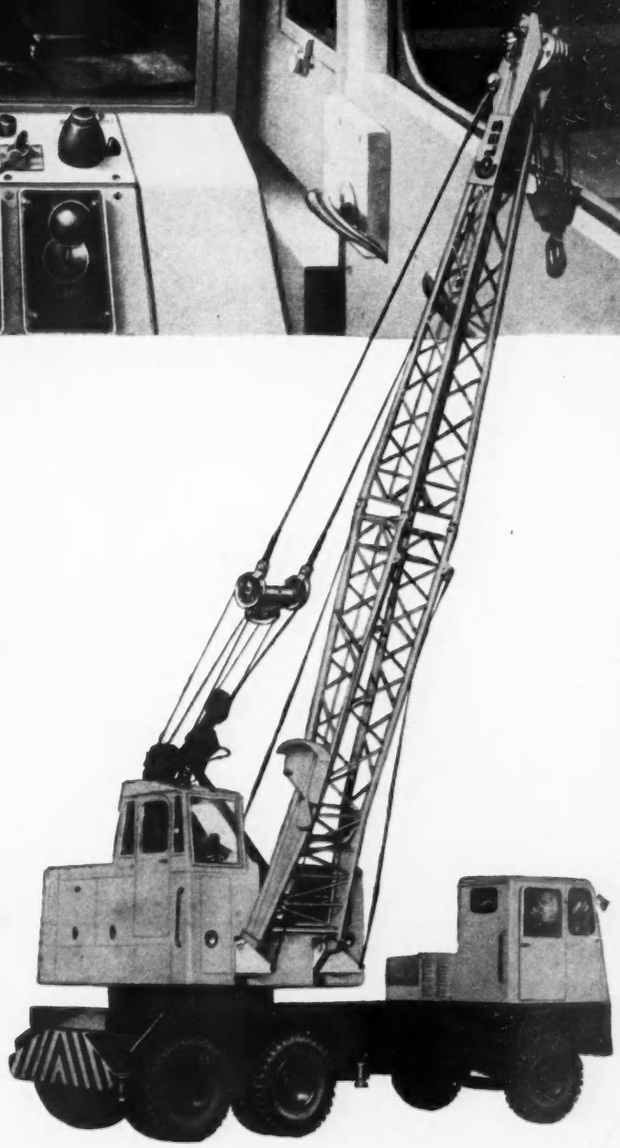

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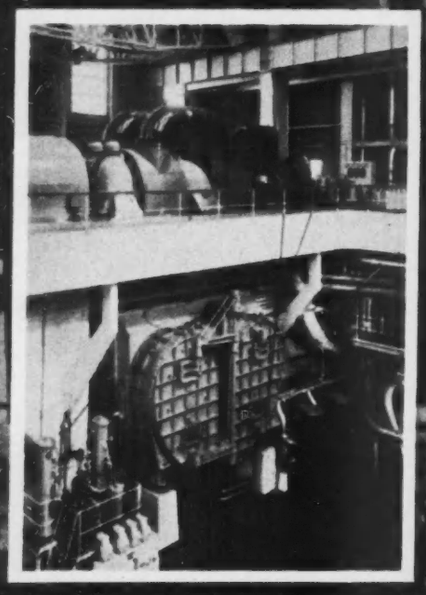

One of three PARSONS 60 MW turbo-generators and condensing plant at C.E.G.B. Tilbury Power Station.

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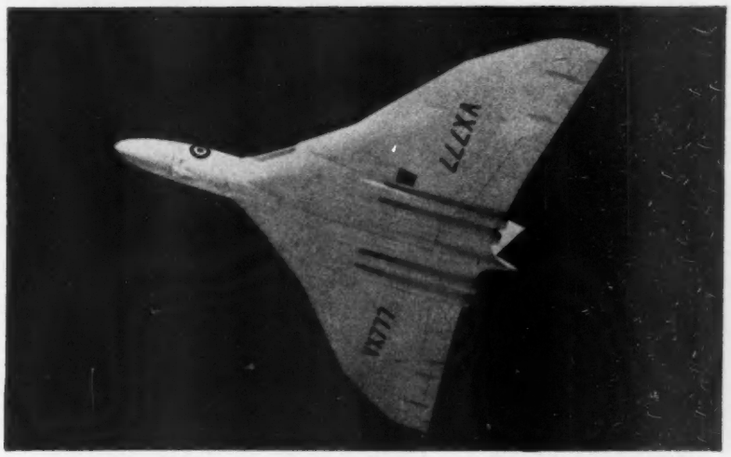
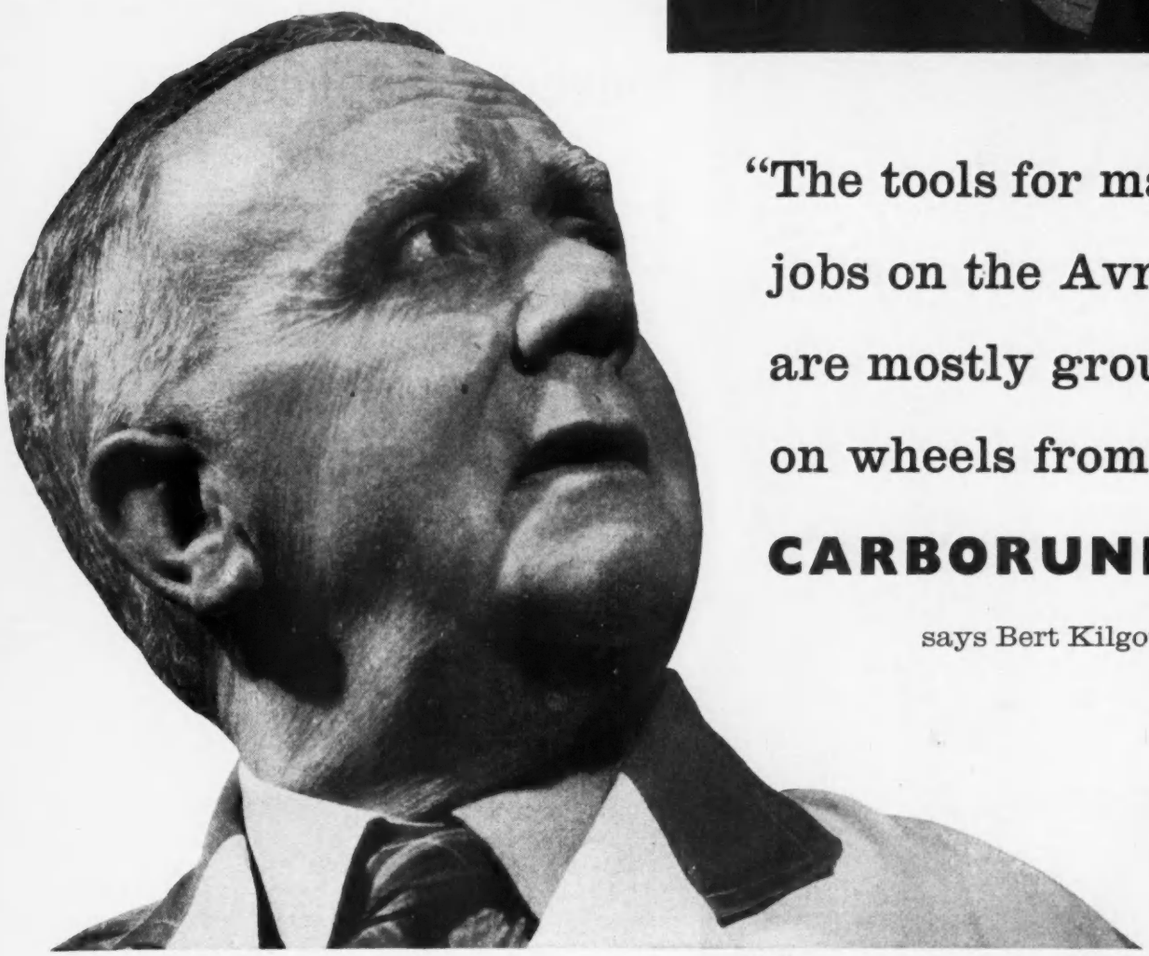
Bert Kilgour has worked at the main factory of A. V. Roe & Co. Ltd, at Chadderton, for 40 years, and is now the senior foreman of the toolroom, in which 300 men are employed: "Must be one of the biggest toolrooms in the country", Bert says. "We started getting grinding wheels from CARBORUNDUM in 1936, and they've supplied most of our wheels ever since then. That's for the whole factory—not just the toolroom. Why? Well, because their wheels do a good job, and give us good service. They've always been ready to help us when we've asked them to."





"The tools for machining jobs on the Avro Vulcan are mostly ground on wheels from CARBORUNDUM"

says Bert Kilgour

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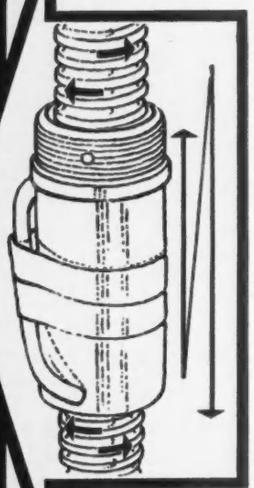

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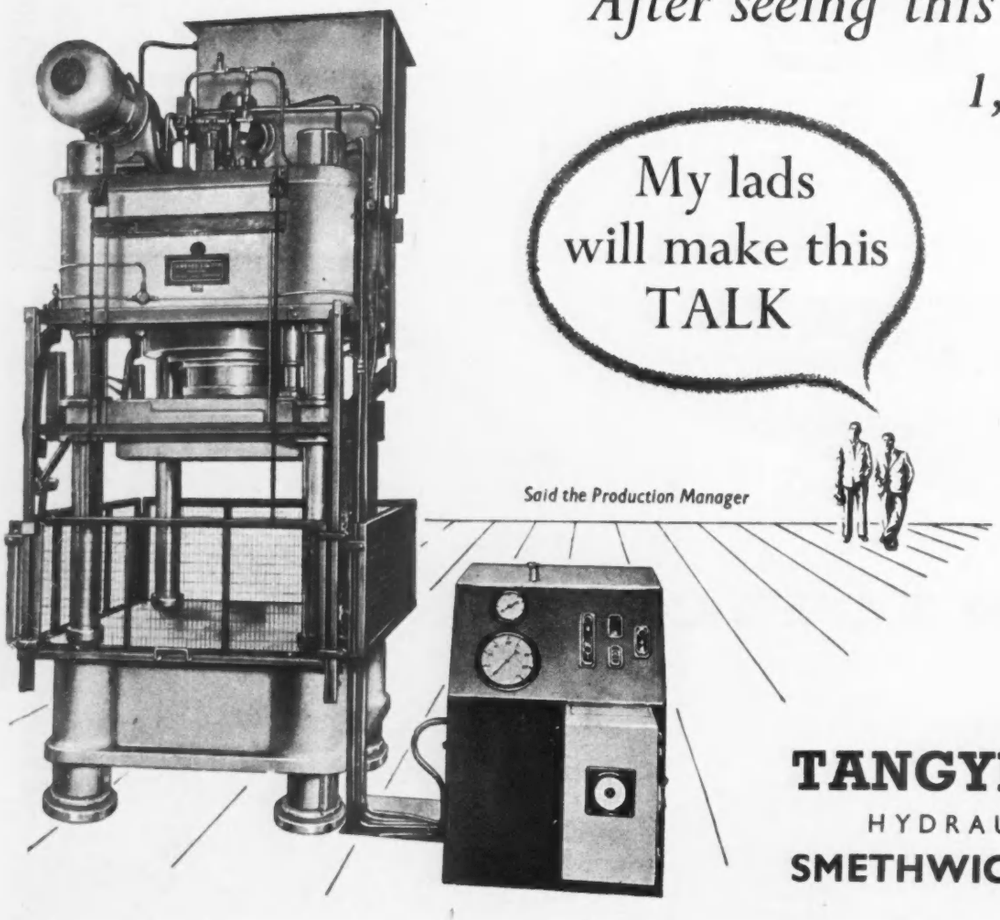

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THE ENGINEER

No. 5394 JUNE 12, 1959 VOL. 207

THE " SET PIECE " OF THE ROAD PROGRAMME

The second of Mr. Watkinson's press visits to the London/Birmingham motorway works was staged last week, when a cortege of Land Rovers packed with journalists and officials toured impressively through the rain from Pepperstock Junction to Tingrith. The occasion was further graced by the contractors' aircraft, a " Rapide " and a helicopter, and by their descent on to the carriageway. Such attention and " news value " might be expected to accompany, for instance, a horse race, but how unexpected, and how long overdue that it should be accorded to a feat of civil engineering ! Journalistic and public interest in this country's major civil engineering works is scarcely ever more than faint-hearted, a fact which we have bemoaned on earlier occasions. The motorway works are certainly out of the ordinary, and worthy of this attention ; that they are receiving it is perhaps due to the energetic aims of the Minister himself, but whatever the reason the results are laudable.

Speaking on this occasion, Mr. Watkinson referred to the London/Birmingham motorway, and the St. Albans by-pass motorway which is a continuation of the route to the south, as the " set piece " of the road programme, and in planning it, he said, he had deliberately tried to present to the civil engineering industry a task which would be " probably a real world beater." That his challenge had, in fact, been energetically taken up was made evident by the facts given by Mr. Maurice Laing. These relate only to the London/Birmingham motorway itself, and not the St. Albans by-pass ; they can be quoted without comment, since comment is clearly superfluous. The volume of work on the motorway, Mr. Laing said, had never been exceeded anywhere else in the world. For the past few weeks concrete had been placed at a rate of 30,000 cubic yards per week, and the present rate was 40,000 cubic yards per week. Similarly, asphalt had been placed at 12,000 tons per week, and soon progress would reach 20,000 tons per week. Bridges had been completed throughout the construction at an average rate of one every three days. The job involved 3000 men and 2000 vehicles, and was equivalent to progress valued at £150 per minute, or the completion of 7ft per minute of 36ft carriageway. Mr. Laing praised the civil engineering " operative," as he called him, whom he considered the best anywhere. But he was rather coy about predicting completion of the job on schedule. It must be remembered that last summer was very wet—" the wettest in living memory "—and this mighty task is due for completion in two summers. It speaks volumes for the organisation of the work that the programme was not completely wrecked by last summer's weather, but we were able to record in our Annual Review Supplement last January very substantial progress, and the works are generally up to date. So they are now, but those concerned, we gathered, are " keeping their fingers crossed " for a fine summer. Progress to May 31 last can be summed up as follows, all these items representing completed work or completed dual carriageways : bridges, 112 ; granular sub-base, 45 miles ; reinforced concrete marginal haunches, 38 miles ; dry lean concrete base course, 32 miles ; asphalt surfacing, 6 miles. Attention will be on the surfacing this summer, a rate of 3½ miles per week of motorway having already been achieved for this work.

Some explanation of the design and construction of the motorway has already been given in these columns, but a more complete account will be more timely at about the time of completion. Here we should also mention the exceptional interest of the St. Albans by-pass, where concrete carriageways are being constructed which, it is considered, will set a new standard in riding quality for this sort of construction. The five organisations concerned with these two roads, are Sir Owen Williams and Partners ; the chief engineer of Hertfordshire County Council and his staff ; John Laing and Sons, Ltd.; and Tarmac Civil Engineering, Ltd., and Cubitts-Fitzpatrick-Shand. We wish them every success this summer in bringing this country's first motorway route on a national scale to completion on time. With the efficiency so far made apparent, it seems that Mr. Watkinson's challenge will be met, and, indeed, will set the standard for some of the major works which the road programme will soon see undertaken. At present only one aspect of this vast undertaking seems to invite criticism : the modernity and sweeping line of the London/Birmingham motorway is not matched by some of its concrete bridges which appear unduly ponderous and do not exhibit the slim elegance we have come to expect in contemporary design in concrete.

EDUCATION OF TECHNOLOGISTS AND TECHNICIANS

In an admirable review of a book (*Education and Freedom*) by Vice-Admiral Hyman G. Rickover, Mr. Frederick S. Blackall junior remarks how " the Admiral's analysis of the elementary and secondary schools of our nation recites in convincing detail the manner in which our public schools have drifted away from fundamentals to frivolities ; from the development of merit to the pampering of mediocrity ; from the inculcation of basic principles to the cult of ' know-how ' courses. It will come as a surprise to many to find here a scientist who is appealing for the return to a liberal arts programme of high quality and sound content as the only proper approach to higher learning in the professional fields and especially in engineering and science." While Admiral Rickover writes from the point of view of a critic of the American educational process, his words cannot fail to prove thought-provoking to those concerned with the British educational process, respecting which Mr. Blackall quotes the Admiral as remarking that : " If we don't promptly revise our educational methods, as England, Germany, France, and the Soviets have done, we shall stand in grave danger of losing the race with Russia." Admiral Rickover strongly supports the emphasis now being placed—not for the first time—

on the need to direct special attention to the training of those men who give evidence of being able to cope with the educational process above the vocational level. "Unless," writes Rickover, "we abandon false 'democratic' clichés which interpret democracy as enthronement of the commonplace and obstructions of excellence, we may find that we have traded freedom for a mass of pseudo-democratic mediocrity." Unfortunately, we have no means for detecting (by tests such as those effectual in revealing defects in material) cracks in the intellectual make-up of potential engineers. On this Rickover remarks that "Technological progress is limited by availability of trained professionals and this in turn largely depends upon . . . superior brain power over which we have little control and development of available talent—here we can do much!" It could, of course, be asserted that during recorded human history there has never been a period when the sources of engineering talent have dried up. They have not, it is true, provided any uniform output, qualitative or quantitative, but whether the illuminating power came from the farm, the workshop or the laboratory the torch has continued to burn.

In an article to be printed soon in THE ENGINEER reference is made to the work of John Rennie and his sons George and John. Whether it was in connection with canal building, bridge building, dock and harbour building, engine building, or millwrighting, the Rennies made history and not less valuable than the splendid work which they performed is the luminous example which they have bequeathed. Whatever they touched they endeavoured to adorn and it has indeed been written of the beautiful bridge built by John Rennie over the Tweed at Kelso in 1799, that "the scenery around this structure is admired for its beauty, and the conflux of the Tweed and the Teviot rivers is enriched by the engineer." If the Rennies were artists as well as engineers we must not forget that they were also tireless in their investigations into the strength of materials and that it was the performance of a ship which they engined—the "Archimedes"—that caused Brunel to abandon paddle-wheel propulsion for the "Great Britain" and fit instead a screw propeller designed by Pettit Smith. We do well to remember that the working atmosphere in which the Rennies were brought up stemmed from a powerful educational background whose impact is to be seen not only in the equipment of the Albion Mill in London and the machinery of the "Archimedes," but in such structures as the three-arched bridge in Hyde Park which, designed and built by George Rennie, remains a perpetual source of pleasure to all beholders. At once scientists and millwrights, technologists and technicians, the Rennies would have rejoiced the heart of that great educator Quintilian. Active in the first century A.D. Quintilian laboured for the evolution of complete citizens who, possessing knowledge, had also acquired the wisdom to apply it well. Let us hope that the present efforts of our educationists may, like his, be concentrated on the training and encouragement of technologists and technicians who will also prove citizens in the truest sense of the word.

ALLIED RETALIATORY POWER

Both the British and United States defence chiefs are convinced that manned bombers will continue for some years yet to provide the main allied deterrent and retaliatory power. Indeed, they are satisfied that in the coming missile era the manned bomber will still be required if there is to be flexibility of operation. Both nations are therefore strengthening and modernising their strategic bombing forces, though each has a different aim in view. In the opinion of the British Government, this country could not prevent a dozen H-bombs being dropped on it and even so small a number would paralyse it, industrially and economically. The purpose of the V-bombers is thus to prevent war and not to wage it. The American people, on the other hand, are encouraged to believe that they would manage to survive a nuclear war and ultimately gain the upper hand, provided their own strategic bombers are not destroyed or rendered ineffective by a sudden and unexpected Soviet attack. Since 1957 a limited number of United States bombers have, for this reason, been kept in a state of alert.

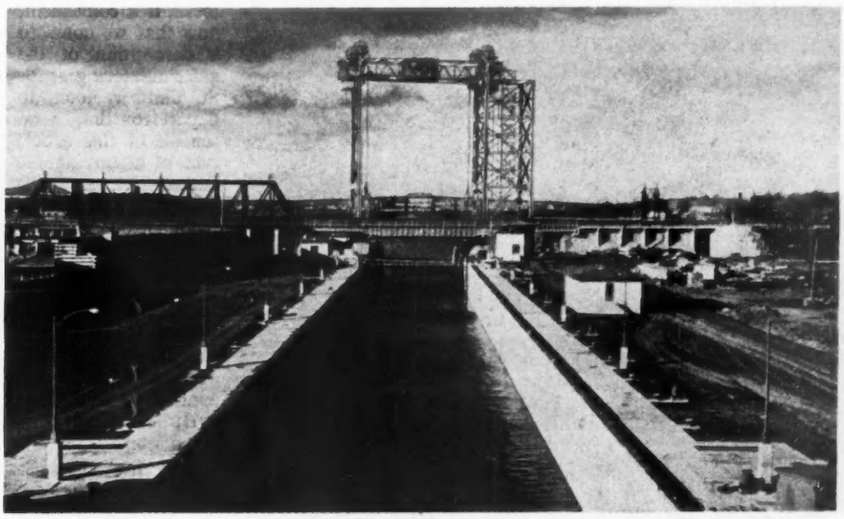
It is thus very gratifying, in view of the substantial and growing share of Britain's defence budget now allocated to the deterrent, that the United States defence chiefs should attach such great importance to the V-bomber force. This is clearly evident from a statement made recently by General Power, Commander-in-Chief of the U.S. Strategic Air Command. "Having regard to Britain's closer proximity to Russia," he said, "we are relying on her V-bombers to provide the first wave of the allied retaliatory force. With their high performance jet aircraft and thermonuclear weapons, they are an essential element of the Western deterrence." It is clear also that in the coming missile era, co-operation in deterrence is being still further extended to include some of the N.A.T.O. countries on the Continent of Europe. While the United States and Britain are planning to use rockets of intercontinental or semi-intercontinental range, it is hoped that both Italy and Turkey will establish bases for the 1500-mile "Thor" or "Jupiter" rockets to be supplied from the United States. Apart from this commitment, and the supply of "Thors" to Britain—a weapon to be used mainly for training purposes in view of its relatively ineffective range and the development of the "Blue Streak"—the United States is now concentrating on the 5500-mile intercontinental rocket. The liquid-propellant "Atlas" and "Titan" will shortly be going into production and the solid-propellant "Minuteman" should have passed its development tests by 1961. All three—as also Britain's "Blue Streak" of semi-intercontinental range—will be launched from underground and thus be reasonably safe from sudden attack. Indeed, there is only one real ground for criticism in the present programme for allied retaliatory power. Despite certain difficulties—we have French objections to the stockpiling of American nuclear warheads in mind—much money is being expended in providing the N.A.T.O. Shield in Europe with nuclear weapons in the so-called tactical range—"Matadors," "Redstones," "Corporals," "Honest Johns" and the like. Even the provision of anti-aircraft guided weapons—which are far from being inexpensive—seems of doubtful value. In the light of the warning given to Russia, a major aggression by the Soviet armies in Europe is no longer in question. The recent change in the direction of Soviet foreign policy, in fact, makes this quite clear. The purpose of the Shield is now to ensure that the Russian Army will not present the Allies with a *fait accompli* by a sudden occupation of a small enclave of territory in Europe.

LATE DELIVERIES—AN APOLOGY

Owing to the present unsettled conditions in the printing industry we regret that some subscribers did not receive their copies of our June 5 issue at the usual time. There will also probably be a similar delay in the despatch of copies of this issue. We wish to apologise for any inconvenience caused by these delays, which are due to circumstances beyond our control.

St. Lawrence River Development

III—Locks and Lock Equipment



Construction of the St. Lambert lock (right), including underpinning the south pier and abutment of the Victoria Bridge, is described. Since there is considerable standardisation in the design of the five Canadian locks of the Seaway, the ensuing description of the lock gates, culvert sluices and other equipment, covers all five locks.

PROCEEDING upstream from the Jacques Cartier Bridge, which was described last week, the next feature on the Seaway is the St. Lambert lock, the most complex of the Seaway sites. The lock is situated at the south end of Victoria Bridge, which is a combined road and rail crossing. The last span of the bridge has been replaced by a lifting span, which crosses the lock just below its downstream gates. A second lifting bridge has been built just above the upstream gates, with spur roads leading to it, for both road and rail. This dual bridge arrangement allows uninterrupted traffic when a vessel passes through the lock, road and rail traffic being directed to whichever of the two bridges is lowered.

There was no choice open to the designers in fixing the position of St. Lambert lock. The only practical possibility was under the last span of the Victoria Bridge. A position further in-shore would have disturbed the built-up area of St. Lambert, and one further out would have restricted the river channel more than the requirements for future hydro-electric exploitation allowed.

The site has been a difficult one. Road and rail routes across it have been kept in use almost continuously. The Victoria Bridge piers, abutting on the Seaway, which are a hundred years old, have been underpinned, and apart from the construction of the lock itself, the two lifting bridges have been constructed, as well as a major land drainage culvert in-shore of the lock, to carry away the run-off from the Laprairie catchment.

Construction of Lock

The lock has useful dimensions, standard to the Seaway, of 766ft by 80ft by 30ft depth over the sill, and a head which varies from 5ft to 23ft. It is of mass concrete construction, with concrete guide walls extending 2950ft downstream and 2300ft upstream. These guide walls open out at 1 in 10 from the lock entrances for 890ft so that a vessel of 75ft beam can lie alongside the parallel wall without obstructing a vessel passing through the lock. The site layout, in common with the rest of the Seaway, will allow the construction of a duplicate lock later on.

The cofferdam in which the lock was built enclosed about 150 acres, extending about 1 mile parallel to the shore, and being built high enough to resist ice jams. Its main embankment later became, in part, the permanent embankment and was of the usual rock-fill construction with an impermeable core—or alternatively a blanket with rip-rap cover—of glacial till. The lock was excavated from shale ; about 0·15 lb of explosive per cubic yard excavated was used at this site, a corresponding figure for the Seaway as a whole being 0·4 lb per cubic yard.

The most critical operation was the under-

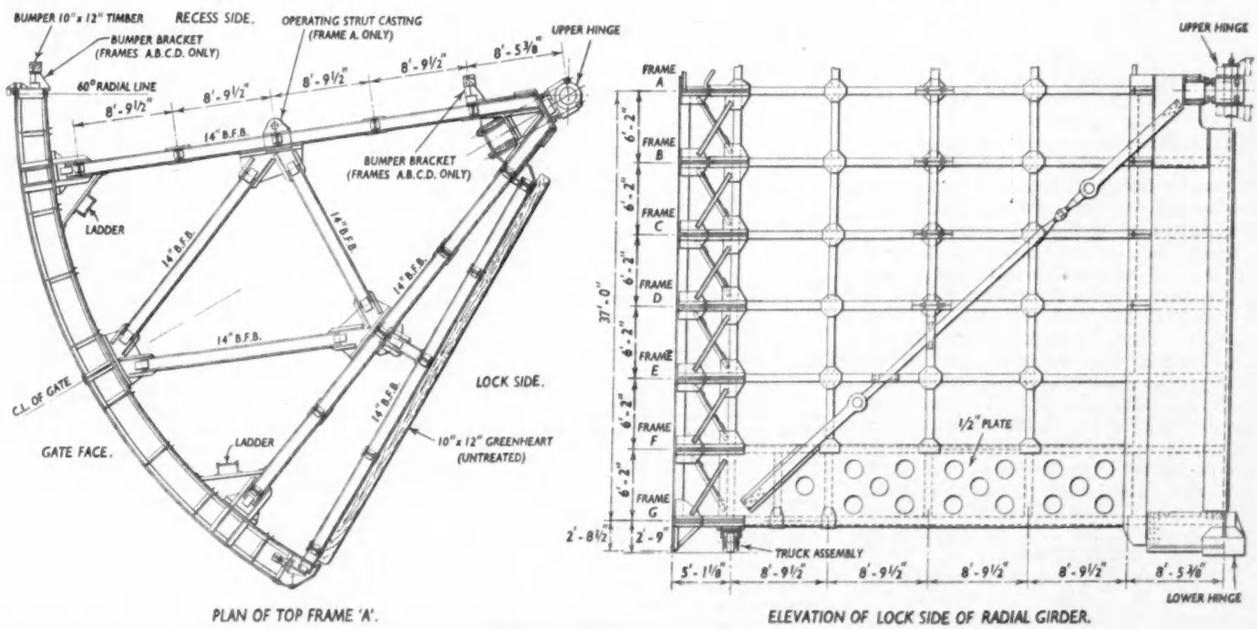


Fig 12—Constructional details of sector gate

pinning of the Victoria Bridge, at its south abutment and the pier next to it, since the lock excavation went about 40ft deeper than the formation level of the bridge footings. A strip 100ft wide was excavated along the centre line of the lock, where it passed under the bridge. Lateral excavation then proceeded to allow a strip of the lock, 12ft wide, to be constructed, and concreted up to the bridge footing. Then, in seven stages, the shale was excavated in 12ft trenches, each concreted in turn, to complete the underpinning. All this took about a year to complete, and was an essential preliminary to the bridge reconstruction. The bridge was in use all the time.

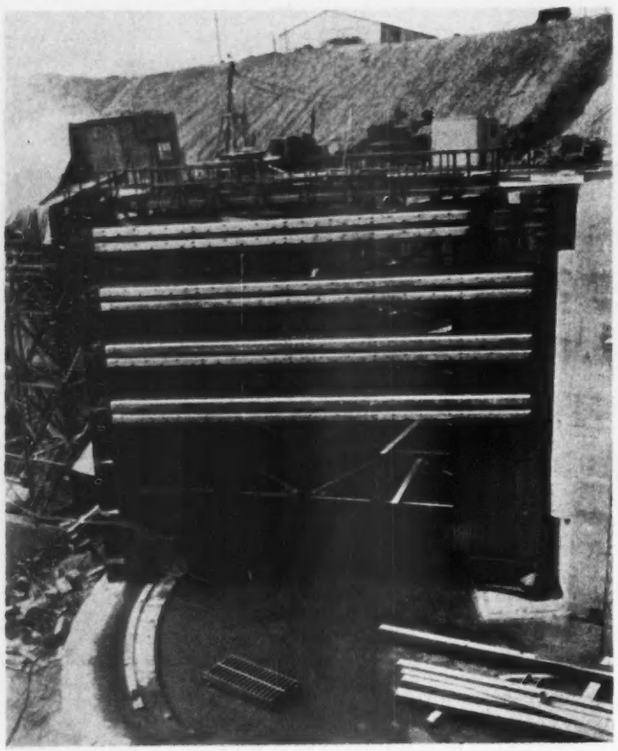


Fig. 13—Sector gate in partially open position showing pintle and hinge, fendering, roller track and sealing strip

Another complication was the need to reconstruct the St. Lambert intake for local water supply, which now passes under the lock. Further, the new culvert through the Victoria Bridge embankment which drains the Laprairie basin, and which has a capacity of 10,000 cusecs when the Laprairie water level is 38ft, had to be in use before the gaps between the principal constructional cofferdams, shown in Fig. 6, *ante*, were closed.

Construction of the mass concrete walls and invert of the lock followed usual practice for this class of work, but was conditioned by the restricted site and the need for rapid progress. There is more concrete in this lock complex than in any other of the Seaway locks, due largely to the underpinning and lifting bridge substructures. A maximum rate of concreting of 70,000 cubic yards in one month was achieved. The invert of the lock is anchored to the shale bedrock by steel anchor rods, grouted into holes drilled in the rock; thus, resistance to uplift is assured, should the lock be emptied for maintenance during the winter.

The St. Lawrence Seaway Authority's contractor for St. Lambert lock and the lock approaches was the McNamara - Pigott - Peacock Construction Company; the regulating culvert and road underpass were built by S. D. Miller and Sons, Ltd.

Lock Gates and Sluices

Since there has been a great deal of standardisation in the design of the Seaway locks, it is convenient, now that we come to a description of the gates and lock gear for St. Lambert lock, to depart from the general scheme of this article (viz. of describing the Seaway by gradually following its route from Montreal upstream) and to describe together these installations in all five of the locks which are the responsibility of the St. Lawrence Seaway Authority. The two United States locks will be described further on.

The five Canadian locks have either sector or mitre gates in various combinations, as enumerated in Table VIII; details of the gates are shown in that table. The mitre gates are single-skin gates of welded construction with bolted site connections. Diagonal braces on the downstream side of each gate are adjustable, and were prestressed to give the gate rigidity. The pintles are of nickel steel, 21in in diameter. The meeting faces between sill and gate are of steel, and the meeting faces at the mitres are also of steel, one convex and the other concave, but to a greater radius. The steel strips forming the vertical meeting face were adjusted and then fixed by pouring molten zinc behind them. The steel strips on the sills were adjusted and then concreted in.

The sector gates are of a design which is considered to have been proved in other Canadian and U.S. canals, and is shown in Figs. 12–14. Its principal merit is that the gates can be opened and closed against fairly rapid flows. At Iroquois lock where the head is 5·5ft, the use of these gates has eliminated the need for filling and emptying culverts, the gates simply being opened to operate the lock, but at a slower speed than quoted in Table VIII. Conditions at Iroquois lock, however, were governed by the head of 24·5ft experienced during construction of the dam nearby and the power station further downstream, and the sector gates were able to operate under this higher head. The mode of operation at that time kept surge to a minimum by opening the gates as follows: (*a*) "inching" 10 per cent of normal speed for the first 3 deg., then stopping for a given period until a specified water level was reached; (*b*) start slowly (10 per cent) for a short distance, then operate at full speed; (*c*) finally "inch" (10 per cent) to fully open position.

These gates are also of single-skin construction. The pintle bearing and hinge are not unlike those of the mitre gate, but in this case there are also rollers under each of the two radial arms of the bottom frame, close to the skin plating. These rollers travel on a steel track. The gates are sealed by rubber strips. Water loads are transferred through the pintle bearing and hinge by the plate girder heel post. The pintle is 30in in diameter.

Although the sector gates at Beauharnois (upper) and Cote Ste. Catherine lock are intended as guard gates, in normal operation they are closed immediately behind downgoing vessels.

We also illustrate in Figs. 15 and 16 respectively the operating gear for a gate (of either kind) and for one of the sector valves of the lock culverts. The former is driven by a 20 h.p. electric motor, which drives the pinion shown on the right of the sketch, through reduction gearing. The pinion, in its turn, drives the sector gear, to which the sector arm is rigidly bolted. The gate operating arm is pinned to the sector arm, and to the gate.

Safety mechanisms are built into this operating gear. The load in the operating arm is measured by the deflection of springs and when it exceeds a given value (75,000 lb), a switch is tripped and the motor disconnected. When the mitre gates are almost closed, they are vulnerable to "back surge"

TABLE VIII—*Lock Gate Data for the Five Canadian Locks*

Lock	Gate arrangement		Head on lock, feet	Other data
	Upstream end	Downstream end		
St. Lambert	1 pair mitre gates; recesses constructed for 2nd pair of mitre gates	2 pairs mitre gates	5 to 23	Height of downstream leaves, 58ft Weight of downstream leaves, 175 tons
Cote Ste. Catherine	1 pair sector gates (guard gates) 1 pair mitre gates (operating gates)	1 pair mitre gates; recesses constructed for 2nd pair of mitre gates	30 to 40	Height of downstream gate leaves, 72ft Weight of downstream gate leaves, 236 tons
Beauharnois lower lock	2 pairs mitre gates	2 pairs mitre gates	32 to 47	Height of downstream gate leaves, 81ft Weight of downstream gate leaves, 257 tons
Beauharnois upper lock	1 pair sector gates (guard gates) 1 pair mitre gates (operating gates)	1 pair mitre gates	33 to 47	Height of downstream gate leaves, 81ft Weight of downstream gate leaves, 257 tons
Iroquois	2 pairs sector gates	2 pairs sector gates	5·5 24·5*	—

* During constructional period.

Sector gate data:

Radius	48·7ft
Included angle	43 deg
Height	43ft
Number of horizontal steel frames	7
Normal opening or closing time	2 minutes
Approximate weight of gates	250 tons

Mitre gate data:

Width of leaf	46ft
Thickness of leaf	5ft
Inclination of closed leaf to transverse axis of lock	4 in 12
Height of all upstream leaves	42ft
Weight of all upstream leaves	131 tons
Normal opening or closing time	2 minutes
Head against which gates can be operated	0·5ft

Standard lock dimensions are 766ft by 80ft by 30ft depth over the sill.

For filling and emptying all locks, flow is by gravity.

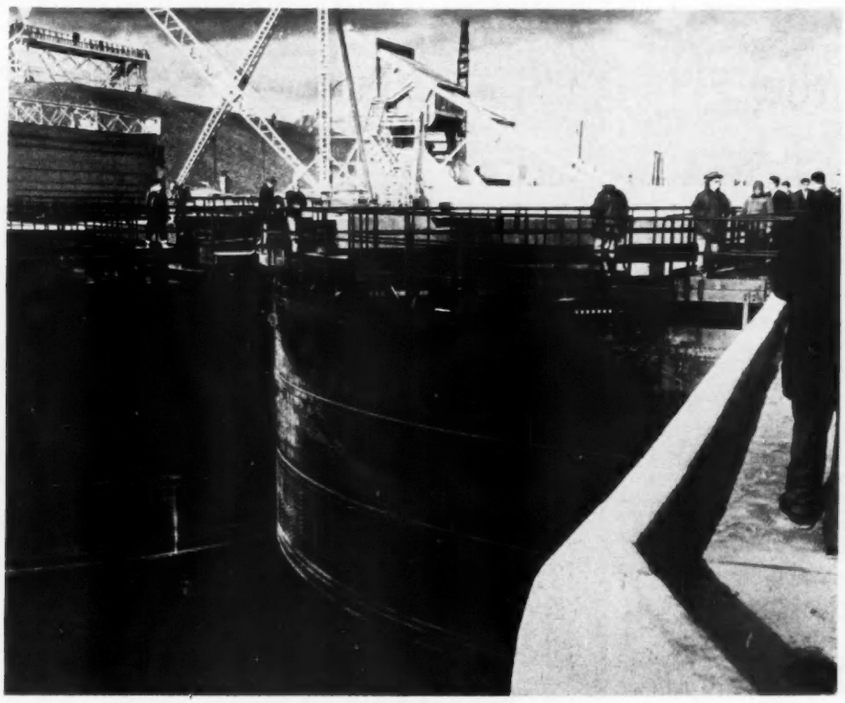


Fig. 14—A pair of sector gates shown from upstream, in the closed position. These gates are at Iroquois

from the screws of a ship leaving the lock. To prevent overloading causing any damage in these circumstances, shear pins are included in the mechanism, which release the gate if the load on the operating arm exceeds 140,000 lb.

The sector or " Taintor " valves controlling the lock culverts operate with the frame in tension, i.e. the water level in the shaft

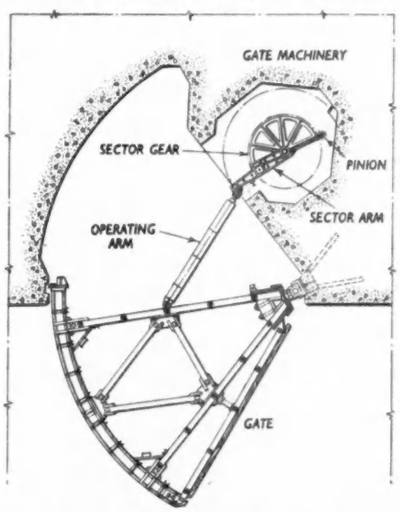


Fig. 15—Operating mechanism for lock gate

shown in Fig. 16 corresponds to the full upstream head (the design head is 94ft). These valves are either of 21ft or 12ft radius, and of 25 tons or 8 tons weight respectively, and are double-skinned, the inner skin being removable for maintenance. They are sealed with rubber. The larger size is standard for the normal lock culverts, the smaller one being used at the by-pass culvert serving the intermediate basin between the Beauharnois locks. The tubular operating arm shown in Fig. 16 pinned to the valve and to a lever higher up the shaft, is driven by a 20 h.p. motor, through various reduction-gearing stages, including two pinion and sector-mechanisms, the last of which is situated in the wet well above the sluice. The operational cycle will, of course, depend on the head at the particular lock concerned, and allowing for " inching " the lock gates close to the fully open and fully closed positions varies from about two-and-a-quarter minutes (St. Lambert) to about eight minutes (Beauharnois).

Hydraulic Model Tests

The hydraulic characteristics during filling and emptying of the Seaway locks were investigated by a series of hydraulic model tests carried out by the Canadian National Research Council at Ottawa. The main idea behind these tests was to reduce the time taken to fill or empty a lock to the minimum consistent with safety. In fact, maximum flows of 10,000 cusecs are reached in operating the locks, and as a result of these investigations the time taken has been limited to eight minutes, corresponding to hawser forces not greater than 10 tons. Models of 1 : 30 scale were employed, and the problem of design was generally similar in all cases except for Iroquois lock, which, as already noted, is the only one which has no culverts. In this case, tests on 1 : 20 scale sector gate models were carried out, to ascertain discharges corresponding to rates of opening the gates. These results were correlated with calculations of the discharges corresponding to acceptable limits of hawser forces.

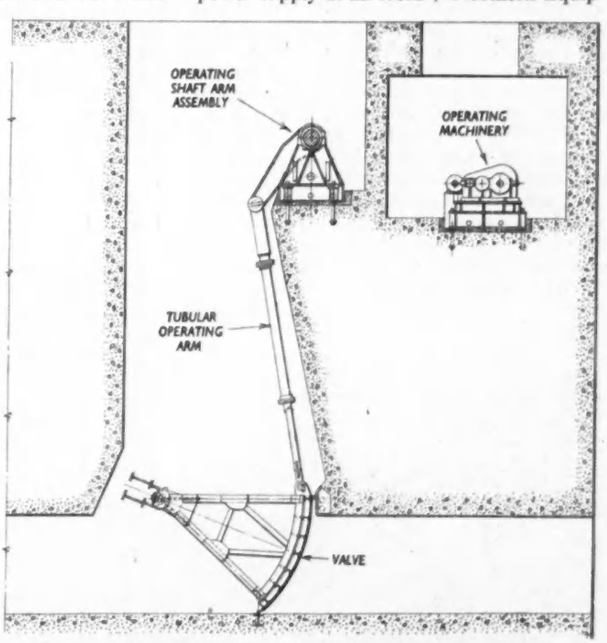


Fig. 16—Sector valve in lock culvert and its operating mechanism

The Seaway locks are spaciously laid out. Taking St. Lambert lock to exemplify them all, there are two operating cabins with control rooms at first floor level, each giving an excellent view of the whole lock.

On each side of each set of lock gates and on each side of each of the lifting bridges, there are fender booms which are raised only when the way is clear for the ship to proceed. Each fender boom has a three-part double system of 1¼in wire rope stretched across the lock, which unwinds, if a ship hits it, through friction bollards and then through drums gear-connected to friction brakes.

Steel stoplogs, with nylon rope and rubber seals, are also stacked at each end of each lock, and a Scotch derrick is installed at each of these points, with a latticed lifting boom, for placing them in position. The lock is amply provided with bollards, and it has a steel kerb along the coping, to prevent undue wear from hawsers. There are four electrically operated capstans on each side of the lock.

One other major installation of plant is that of the pumps for draining the lock, should this be necessary for maintenance when the navigation season is over. A mixed-flow pump driven by a 280 h.p. motor is installed in a deep well at the downstream of each of the locks, except the upper Beauharnois lock, which can be drained by gravity. The contractors for this work were :—

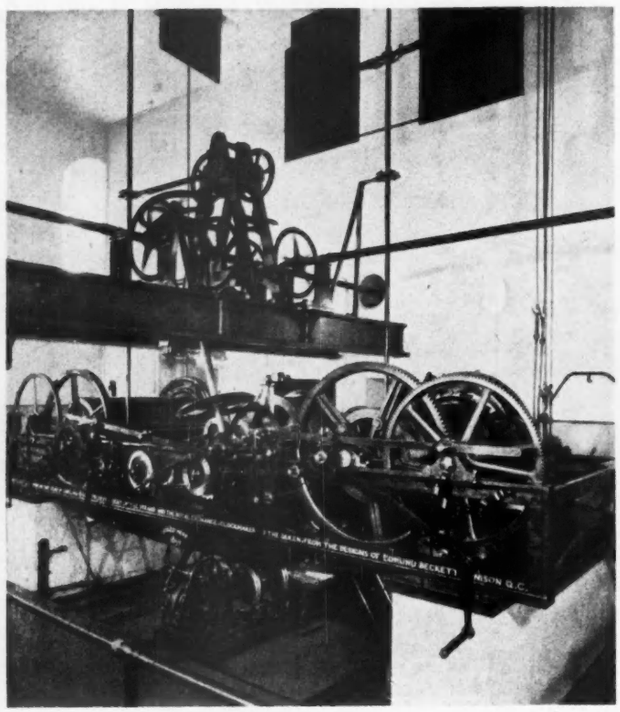
Canadian Vickers, Ltd., all mitre gates and operating machinery for all lock gates ; Dominion Bridge Company, Ltd., all sector lock gates ; Canadian Ingersoll Rand, pumps at all locks ; Bridge and Tank Company of Canada, Ltd., tainter valves and valve-operating gear at all locks, rolling lift bridges at Cote Ste. Catherine and Iroquois locks ; Northern Electric Company, Ltd. (Montreal), power supply at all locks ; Northern Equipment, Ltd., stand-by diesel generators at all locks ; J. M. Gest, Ltd., Metropole Electric Inc., and Donovan Construction Company of Canada, Ltd., electrical installations and substations ; Canada Iron Foundries, gates and operating gear at St. Lambert and Beauharnois culverts ; Timberland Machines, Ltd., " stiffleg " derricks at all locks ; Maritime Steel and Foundries, Ltd., wire rope fenders at all locks.

(*To be continued*)

Centenary of the Westminster Clock

By T. R. ROBINSON

The construction, 100 years ago, of the Great Clock for the Palace of Westminster, was a very significant development in horological engineering, for it was not only the largest tower clock that had ever been made, but it also marked a break with the tradltional design that had remained almost unaltered for centuries. Its flat-bed frame, then a novelty, provided much greater rigidity and improved accessibility : and its gravity escapement, which was evolved especially for the clock, enabled it to set standards of accuracy for tower clocks which had until then never been capable of anything like precision in timekeeping. Almost all modern tower clocks follow the basic design of the Westminster Clock, and the gravity escapement is now the accepted form wherever very precise timekeeping is essential.



NO single piece of mechanism in existence has achieved more world-wide fame than the great clock in the tower of the Palace of Westminster in London, and so its completion on May 31 of 100 years of remarkably precise timekeeping is a notable and historic event.

Although a full century has elapsed since it was set in motion, it can still claim to be the largest, most powerful, and most accurate purely mechanical tower clock in the world, and to have played an outstanding part in securing for British tower clocks the leading position which they still retain.

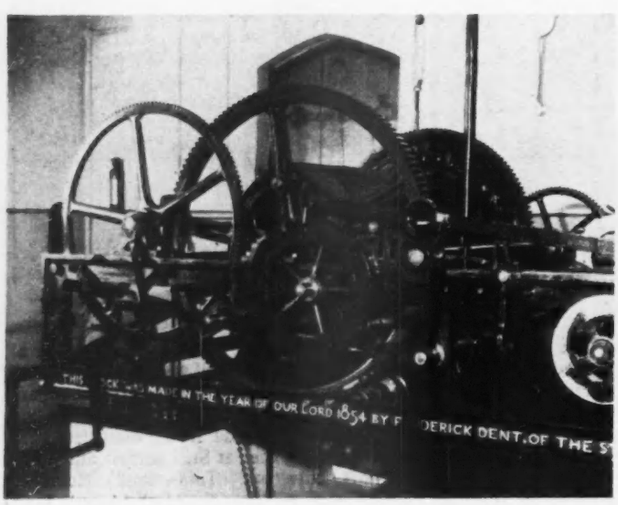
The history of the clock is interesting, for it seems that when the Chief Lord of Woods and Forests (the odd title then given to the Minister of Works), stated that " A King of Clocks, the biggest the world has ever seen " would adorn the new building that was being erected in Westminster, neither he nor anyone else had any notion as to how this grandiose promise could be fulfilled !

Mr. (afterwards Sir) Charles Barry, the architect, had indicated that his plans included a great clock that would show the time on four dials, each 30ft in diameter, chime the quarters on eight bells, and strike the hours on a bell weighing 14 tons ! He suggested that the clock should be designed and made by Mr. Benjamin L. Vulliamy, who was considered by many to be the leading clockmaker of his day.

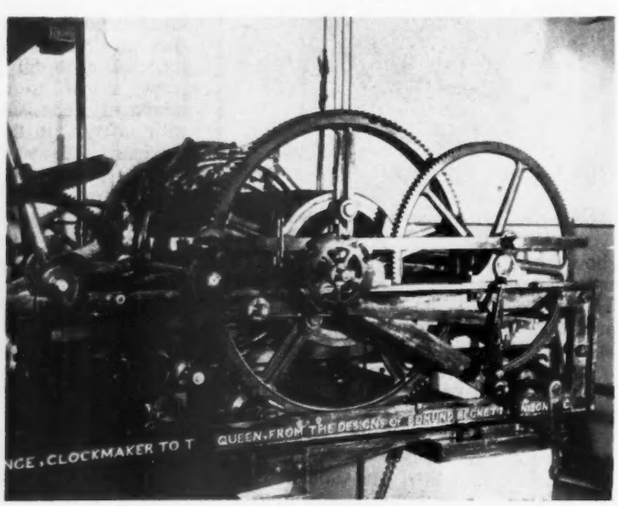
Barry asked Vulliamy to prepare drawings and specifications, but, after various disagreements, and some strong protests from other clockmakers against the methods that were being adopted, it was decided that Mr. George Airy, the Astronomer Royal, should be appointed to lay down conditions, inspect designs, obtain tenders, and act as adviser and referee.

When Airy drew up his specification, two of his demands caused consternation, for he not only required that the great clock should keep time to within a second a day, but also that it should telegraph a signal to Greenwich Observatory twice a day in order to enable a close check to be kept on its performance. No public clock in the world had ever before had to face such an exacting standard of timekeeping, which virtually imposed the accuracy of performance given by a good observatory timepiece on a large public clock with exposed dials of tremendous size. Vulliamy, and a number of other leading clockmakers, regarded the requirements as impossible to meet, and even sent to Parliament to appeal for some easing of the demands. Airy utterly refused to alter his specifications, and, after the matter had dragged on for some years, called in Edmund Beckett Denison, a barrister and a keen amateur horologist, to assist him with technical advice.

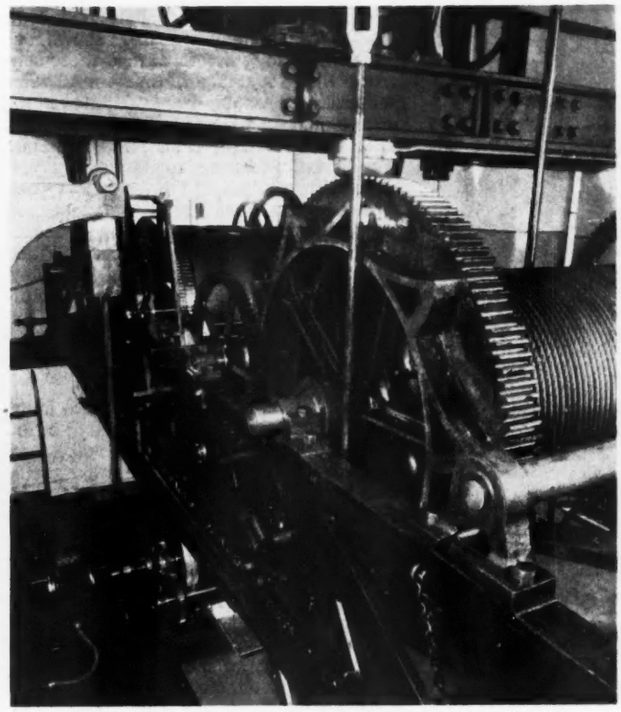
Being a man of great energy and determination, Denison soon made his presence felt. He dismissed all the protests that the clock could not be made to perform to the specified accuracy as indications that those protesting lacked the neces-



Close-up of striking train, showing locking plate and hand-winding reduction gear



Close-up of the chiming train, showing detents, chiming cams and hand-winding reduction gear



The hour striking cams, the pendulum bracket and the winding motor

sary skill to make the clock, rejected Vulliamy's designs, deeply offended Barry by some sharp criticisms of his methods and his architecture, and, with the agreement of Airy, chose E. J. Dent as the man to make the clock, subject to the provision that Dent should work from designs produced by Denison. With this decided, the order for the clock was given to Dent in February, 1852.

Having awarded the contract to Dent, official views soon seem to have undergone a change, and attempts were made to revoke the order. Denison, however, took a very strong line, and Dent was able to proceed with the construction of the clock until his death in 1853. He was then succeeded by his stepson, Frederick J. Dent, and another attempt was immediately made to repudiate the contract on the grounds that Frederick Dent had no right to carry on with it. Frederick Dent was a clever, but a very modest and retiring man, and without Denison's support, he might have been prevented from continuing. Denison, who was stubbornly persistent in such matters, was determined that the clock should be built, and he thrust aside all opposition, using his legal skill to confirm the position of Dent as maker and himself as designer.

The design chosen for the clock was a very sound one and, in many ways, represented a marked break with the accepted practice in tower clock making. Almost all clocks made previously had what was known as a "bedstead," or "birdcage" frame, the two names being almost self-explanatory. Such a frame resembled an old-fashioned "four-poster" bed, and consisted of upright corner-posts, united at the tops and bottoms by cross-bars which were, in turn, spanned by further bars carrying the bearings of the various wheels and similar moving parts. Frames of this kind had been the usual form used for tower clocks since the fourteenth century with very little change in design, but they were clumsy, structurally weak, and rendered upkeep and repair difficult.

Denison had seen an early form of "horizontal," or flat-bed frame that had been introduced by some French makers, and had appreciated its good qualities. He made some modifications of his own to the design, and used the resulting frame to give greatly improved rigidity and accessibility to tower clocks. In most cases, the frame resembles a sturdy cast iron table, or bed-plate, to the planed top and bottom surfaces of which are bolted the bearing blocks for the wheels and similar parts. Such an arrangement has the advantage that it permits almost every component part to be dismantled and reassembled without interference with neighbouring parts. One or two clocks of average size had already been made to this design under Denison's supervision, and he was fully convinced that the flat-bed form of frame was essential for the Westminster clock. His design, accordingly, provided for a large horizontal frame, made up of two main girders of cast iron, having a length of 15ft 6in, spaced and united by four sturdy cross members, each 5ft long. The two cross members nearest the middle of the frame were themselves arranged to be spanned by a further "longways" member, provided to carry some of the bearing blocks of the timekeeping part of the clock. As is usual in a chiming clock, the Westminster movement was designed to have three sets of wheelwork (or "trains," to give them their horological title), one for timekeeping, a second for quarter chiming, and a third for striking the hours. The timekeeping part was located in the centre of the frame, with the chiming and striking parts on the right and left respectively.

The double three-legged gravity escapement. Note the shortness of the lower parts of the gravity arm

When first planned, the timekeeping part of the clock was very different from the form it eventually assumed, and it was during the experimental work in connection with its mechanism that the gravity escapement, possibly the most outstanding horological invention of its kind ever devised, was evolved.

The most serious difficulty that had to be contended with in obtaining a high standard of timekeeping from any tower clock was that the weather conditions affecting the external hands caused variations in the power reaching the escapement, and so altered the "impulse"—the energy delivered to the pendulum to maintain its swing. With a varying impulse, good timekeeping was impossible, and a tremendous amount of effort had been devoted by horologists to the problem of overcoming these variations.

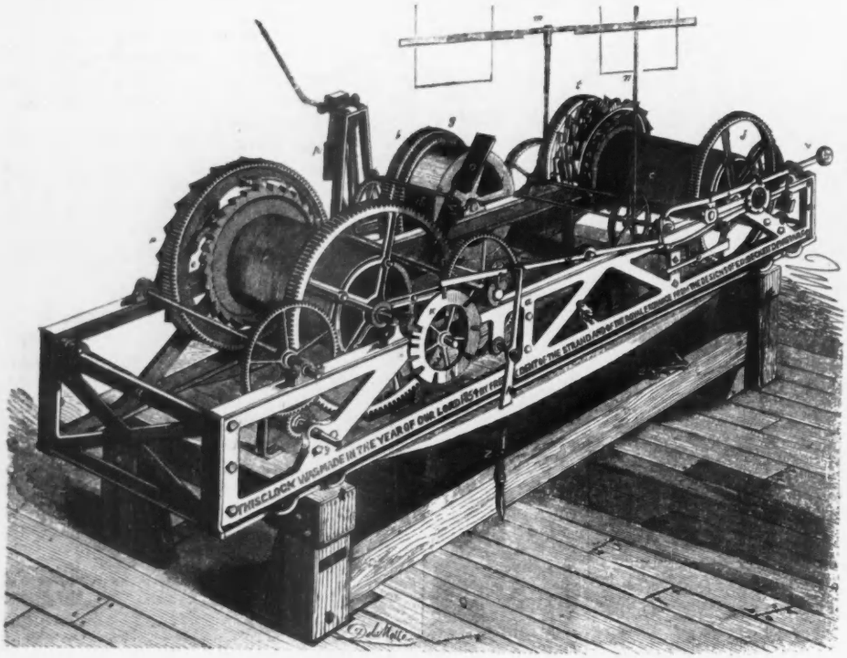
The most effectual device in use at the time when the first plans were being made for the Westminster clock was the "remontoire," in which the main force of the timekeeping part was arranged to wind up a small weight or spring at frequent intervals, usually every minute or half-minute. The small weight or spring then drove the escapement, and, as it was not directly influenced by variations in the main driving force, it delivered a much more even impulse to the pendulum.

A spring-driven remontoire of this kind was actually fitted to the timekeeping train of the Westminster clock during a part of the time it was in Dent's workshops, and, working in concert with a dead-beat escapement, gave fairly good results. The escapement used at this time was a very unusual form of dead-beat, its escape wheel having three long teeth, later given the more appropriate title of "legs," which engaged with a four-stepped perforation in a steel plate, which gave locking and impulse at the correct instants.

The strange characteristic of this piece of mechanism was that, although neither Denison nor Dent realised it at the time, it gave a definite lead towards the invention of the gravity escapement that was to enable the great clock—and subsequently many thousands of other tower clocks—to give a much greater precision of timekeeping than even Airy's stringent demands had called for.

A further development replaced the three-legged wheel with one of slightly different form, in which the legs, in engaging in turn with two blocks set on the side of an oval plate, only performed the locking action, the impulse being given by three small pins of triangular section set on the side of the wheel much nearer to its centre. The object of this design was to reduce the locking friction of the escapement, but in inventing it Denison was "almost there"!

Whilst experiments with this "single three-legged dead-beat escapement" were in progress, Denison saw the rather delicate form of gravity escapement that Bloxam, a fellow barrister, had devised for use on regulator clocks, and by a brilliant flash of insight, realised that his own three-legged wheel and its central impulsing pins could be arranged to raise and lock two gravity arms instead of impulsing the pendulum directly. This was a tremendous stride forward, for in one step it enabled the pendulum to be impulsed by the most constant force known—that of gravity—and at the same time practically detached the pendulum from all interference from the rest of the clock mechanism. In achieving this, Denison had solved the



Movement on test in Dent's factory—1857. Note the striking train, afterwards modified, the escapement afterwards replaced, and the pendulum bracket " on the frame "

problem that had defeated horologists for several generations, for with all other escapements the pendulum had been, to some extent, linked to the wheelwork, and affected by the frictional variations to which it was prone.

Airy had, by this time, for various reasons, resigned the position of referee on designs, but, on being asked, as a matter of interest, to test the new escapement, tried it out and expressed his full approval of it.

The single three-legged gravity escapement was, accordingly, soon fitted to the Westminster movement, but was soon afterwards replaced by a still further improvement. This was the " double three-legged " gravity escapement, which, as its name implies, employs two three-legged wheels, set at an angle of 60 deg. to one another, and spaced slightly apart, with the three gravity arm lifting pins set between them.

The purpose of the double three-legged form of escapement was to reduce as far as possible the unlocking friction, and in this it was remarkably successful. As the escape wheel advances 60 deg. each time it is unlocked, a fly or air brake was fitted beside the escape wheel to reduce the impact on locking, and this device proved quite effective.

The escapement was such an unqualified success that the remontoire mechanism proved completely superfluous, and was removed, thus greatly simplifying the timekeeping train. This did introduce another difficulty, for, as the train no longer advanced in definite half-minute steps, the precise discharge of the hour striking train necessary to ensure that the first blow at each hour coincided exactly with the instant of the hour called for an additional device. The problem was solved by the addition of a precision let-off, in which the release of the striking was first performed by the main cam on the spindle rotating once each hour, and the final moment of discharge transferred to a second, faster moving cam on the spindle of the timepiece train wheel that rotates once in fifteen minutes. The greater angular motion of this second release cam at each beat of the pendulum enables very precise release of the striking to be obtained.

Whilst Denison and Dent were bringing the clock to a state of completion, they were being continually harassed by the intrigues, blundering and, in some cases, the deliberate opposition of various government officials, who seem to have tried, in every possible way, to avoid doing anything which would involve them in taking the responsibility for any decisions.

One of the results of this way of doing things was that it was not until the clock was nearing completion that anything was done about the production of the quarter bells and the great hour bell, although Denison had written to the Board of Works three years before, advising it to take some steps in the matter. Barry had certainly stated that the hour bell was to weigh 14 tons, but he did no more than that, and does not even seem to have made any attempt to find out what the size of such a bell would be.

Eventually, Denison was asked to design the bell, and when he did so, he modified the accepted form slightly to meet the special conditions, a thing which seems to have greatly troubled the bellfounders. The contract for the casting was given to Messrs. Warner, who also cast the four quarter bells. These quarter bells were made without incident, but when the hour bell was cast at Stockton-on-Tees, things went wrong. By some mischance, metal ran short, and rendered the crown of the bell defective, and when the bell was removed from the mould it was found to weigh 16 tons instead of 14, a thing the founders could not account for.

After various mishaps, it was eventually delivered to Westminster, and hung for testing. As a 7 cwt hammer, used at the foundry for testing, had failed to bring out much sound, tests were made with a 13 cwt one, and although this did bring out the sound, the bell cracked soon after.

After a further delay of two years, it was decided that the bell should be recast by Mr. George Mears, of Whitechapel, again from designs supplied by Denison, who decided that the recast bell should be smaller than the previous one. The second bell was more successful than the first, but Denison was never satisfied with it, and only agreed to its acceptance under protest, contending that it should really be recast a second time.

When the bells became available, tests with suitable clock hammers had shown, as Denison had long before warned those concerned that they might, that considerable modifications would be essential to the striking and chiming parts of the clock. These involved larger cams for the hammer lifting levers, alterations to the winding gear, and certain changes in the ratios and positions of several of the wheels. A comparison between the clock as shown in the woodcut appearing in THE ENGINEER in 1857 and photographs of the mechanism as it is to-day, shows some of these modifications. Fortunately, or even possibly because Denison and Dent had foreseen that they might have to be made, the work could be done without altering the main frames.

Eventually, after the bells had been hung, and the bell frame, which was found to be too weak, had been strengthened, the clock was installed. On being started, it could not be made to run for a full hour, and investigations revealed that the hands, which had been designed by the architect, were far too heavy, weighing about 2½ tons ! Another delay followed whilst more practical hands were being made, but the clock finally began to run on May 31, though the striking and chiming was not heard until some time later.

From the very beginning the timekeeping performance of the clock was so good as to confound all those who had foretold that it could never run accurately. On most days of the years that have passed since, its error has been within 0·2 sec, a truly excellent performance for a clock which has to drive the hands of four 23ft dials through all weathers.

The great two-second pendulum, which is compensated by zinc and steel tubes, maintains a remarkably consistent arc, and is capable of extremely precise adjustment. It is worth mentioning that the statement that coins are used as supplementary rating weights is quite a true one ! Pennies and halfpennies are used—an interesting point, for the bob, in contrast, weights about 4 cwt !

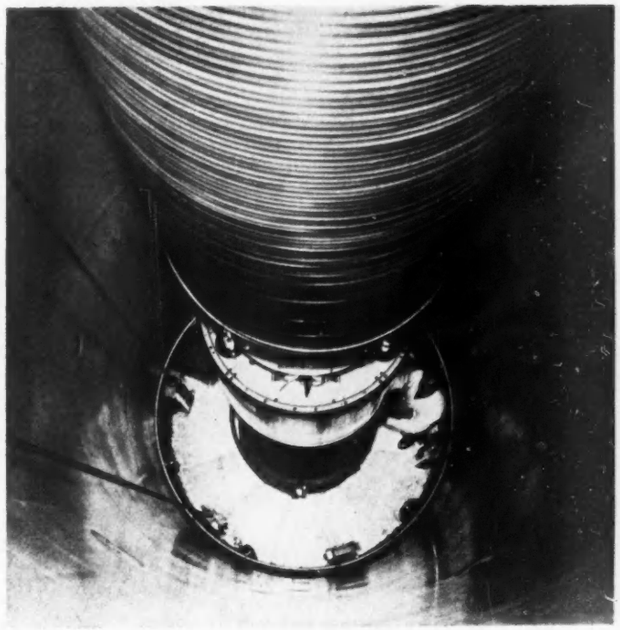
At the end of its 100 years of service, the clock is in perfect mechanical condition, and, with the exception of the fitting of an ingenious semi-automatic electrically powered winding mechanism, is much as Denison, afterwards Lord Grimthorpe, and Frederick Dent left it. The clock is still maintained by the firm of E. Dent and Co., Ltd., which is understandably proud of its charge.

Anglo-American Collaboration on Organic-Liquid-Cooled Reactors

COLLABORATION on organic-liquid-cooled reactor systems is provided for in an agreement made recently between North American Aviation Inc. (acting through its Atomics International Division of Canoga Park, California), and the English Electric Company, Ltd., London.

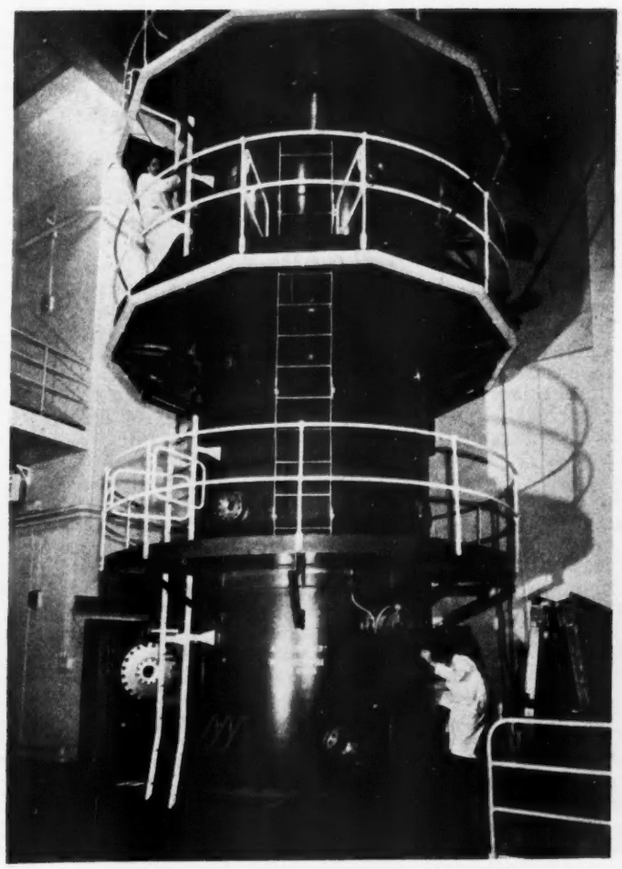
For some years Atomics International has engaged in research and development (much of it in association with the United States Atomic Energy Commission) on the organic-liquid-cooled reactor, which shows promise as a potential low-cost system particularly applicable to smaller nuclear power stations and to marine propulsion. It will be recalled that the resources of the English Electric atomic power division have been mainly devoted, hitherto, to the gas-cooled, graphite-moderated reactor systems for larger power stations. The new agreement implies a considerable widening of the company's interests in the applications of nuclear power.

Nuclear Physics Research at Aldermaston



A tandem Van de Graaff accelerator now in operation in the Nuclear Physics Division, Atomic Weapons Research Establishment, greatly extends the range of investigations which may be conducted into nuclear structures and reactions. A new multi-channel magnetic spectrograph under construction for use with this machine will enable entire spectra to be determined in one exposure. These equipments are described below, and some details are given of other projects at the establishment.

SINCE Easter this year the Nuclear Physics Research Division of the Atomic Weapons Research Establishment, Aldermaston, has had at its disposal a tandem Van de Graaff accelerator with which it will be possible to operate in the near future with voltages of 10 to 12 MeV. Experiments up to about 10·3 MeV have been carried out already. During an inspection of this and other equipment at the establishment on June 2, Dr. K. W. Allen, Senior Superintendent, Nuclear Research, said that the tandem machine had been developed in conjunction with Harwell and with Metropolitan-Vickers Electrical Company, Ltd., to assist research into nuclear structures and nuclear reactions. Voltages above about 6 MeV were difficult to achieve in practice and so far it had only been possible to examine medium- and light-weight nuclei. For heavier particles, voltages around 10 MeV were needed. With the tandem accelerator these higher voltages were possible and with its aid they expected to be able to carry out precise studies on the heavier elements.



Principle of Tandem Machine

The tandem Van de Graaff accelerator differs from the single-stack pattern in that the high-voltage stack extends throughout the height of the machine. Part of the stack is seen in the above illustration, which is a view taken inside the pressure vessel. The principle of operation is based on the fact that if negative hydrogen ions are accelerated to about 5 MeV and then passed through a tube containing gas at low pressure, electrons may be stripped off so that positive ions emerge and these are further accelerated by repulsion from the high-tension terminal. Referring to Fig. 3, the negative ions are produced in a large ion source situated outside the top of a pressurised tank, down the length of which runs the evacuated accelerating tube into which the ions are introduced. An electrostatic generator with charge-conveying belt runs up the lower half of the stack, so that the potential of the h.t. terminal at the half-way point is variable from 1MV to 6MV positive with respect to earth.

Inside the vacuum tube at this half-way point is the "stripper," consisting of a tube of $\frac{3}{16}$in internal diameter and 24in long, containing oxygen at relatively high pressure (20μ Hg). Gas is allowed to stream continuously into the stripper at a rate of 5 cubic centimetres per hour. By pumping hard at either end of the main tube it is possible to preserve its vacuum at between 5×10^{-5}mm and 5×10^{6}mm, while the average in the stripper is kept at 0·02mm. This concentra-

Figs. 1 and 2 (Left)—Part of the 45ft pressure vessel containing the high-voltage stack of the accelerator. (Right)—Tandem accelerator control desk and water window as seen from the upper experimental floor. The television screen for remote metering is in the aperture in the left-hand corner

tion of gas, while retarding the fast ions by only an insignificant amount of energy, is sufficient to strip the greater proportion and convert them to positive ions.

In the ion source (Fig 4) the gas is ionised by the r.f. field of a 20 Mc/s power oscillator and the positive ions extracted, the ion source negative potential being variable between 20kV and 120kV. The beam is accelerated to 160keV and focused before passing to the upper section of the accelerating tube, so that the majority of the beam enters the narrow stripper tube.

Outstanding advantages of the tandem generator are :

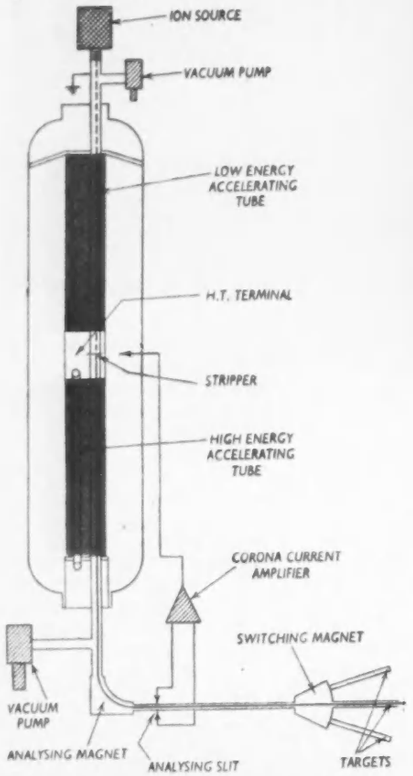


Fig. 3—Schematic diagram of tandem electrostatic accelerator

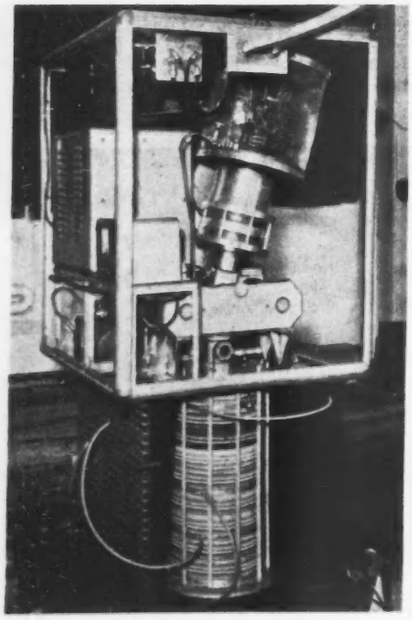


Fig. 4—Negative ion source and injector of the tandem electrostatic accelerator

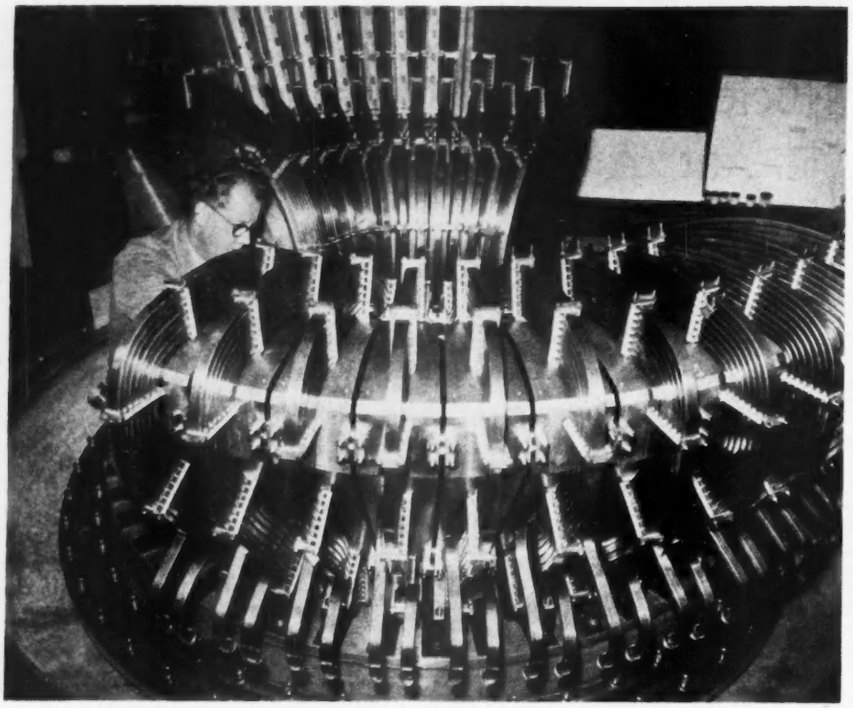


Fig. 5—Magnet of the 24-channel spectrograph in course of assembly

(1) While an electrical potential of only 6MV has to be produced, 12 MeV controllable energy may be achieved. Such energies have hitherto been attainable only in cyclotrons, the energy of which cannot easily be varied. Thus, for the first time there are available beams of charged particles of controllable energy up to 12 MeV.

(2) The ion source, being at earth potential, can be built outside the tube, and so can be made on a much more elaborate scale than in the orthodox Van de Graaff generator. Thus the focusing mechanism necessary to steer the beam into the stripper can be made without undue difficulty. Moreover, the ion source can readily be serviced.

For these reasons the tandem Van de Graaff enables the survey of nuclear elements begun with the smaller machines to be extended, and, hence, allows the exploration of heavier nuclei, having a high nuclear charge which would repel lower-energy particles.

Fig. 1 shows the outside of the pressure vessel, which is 9ft in diameter and 45ft high. Working pressure is 200 lb per square inch. The control desk is shown in Fig. 2. In the left-hand corner panel can be seen the aperture for viewing the screen of the Pye closed-circuit television system which shows the readings of essential meters on the injection and stripper section levels.

Below the machine, on the upper and lower experimental floors, analysing magnets bend the beam through 90 deg. after which, if it is to be used as a neutron source, it is led through a vacuum tube to a target of tritium or deuterium. The deflection varies with changes in the energy of the beam, so that it may touch one side or the other of the " sensing " aperture through which it passes. In that event, the d.c. amplifier increases or decreases the bias on its output triode and causes appropriate adjustment of the stabilising corona discharge (see Fig. 3).

Three electrostatic generators are available at the laboratory as neutron sources, consisting of the tandem machine described above, a 6 MeV machine manufactured by the High Voltage Corporation, Cambridge, Mass, and a 3 MeV horizontal machine by the same maker. The 6 MeV and 3 MeV electrostatic generators are capable of giving up to 60μA of protons, deuterons or alpha particles at the irrated energies with stabilities of ±2kV and ±1kV respectively.

Multi-Channel Spectrograph

On the lower experimental floor a second magnet redirects the beam from the tandem machine so that it may be used in charged particle experiments. A 24-channel magnetic spectrograph is being built for work of this nature. The beam is led down an evacuated tube to a target chamber containing a specimen of the substance whose nucleus is to be disintegrated. When it impinges on the target, nuclear reactions occur and particles of various kinds are emitted. A small cone of particles is accepted by an aperture and enters the spectrograph magnet. Here the particles are deflected at different angles according to their energy and are focused at different points on a nuclear emulsion plate (Fig. 6). The spectrograph is mounted on a gun base so that it may be rotated to different positions relative to the incoming proton beam.

The magnet, seen under construction in Fig. 5, weighs 13 tons and is in the form of a large ring in which are cut twenty-four $\frac{3}{4}$in air gaps at approximately $7\frac{1}{2}$ deg. intervals. Each gap constitutes a magnetic spectrograph in which a homogeneous circular field of approximately 50cm radius serves to focus charged particles differing in energy by as much as 2·5 to 1 on to a nuclear emulsion plate 30in long. The entire magnet, energising circuit and plateholder assembly are contained in a vacuum vessel $8\frac{1}{2}$ft in diameter and 9ft high. The field, of 12,000 gauss, stabilised to an accuracy of $\frac{1}{10}$ per cent, is maintained by a 320-turn coil carrying 1000A at 60V. Supplies are taken from a motor-generator set.

The vacuum of 10^{-4} to 10^{-5}mm Hg is maintained in the vessel by a large oil diffusion pump, 24in in diameter. The twenty-four nuclear plates are 40in by 1in wide and cover simultaneously an angular

range of 5 deg. to 175 deg. Thus a spectrum, and the angular distribution of each component of the spectrum, are determined in one exposure.

Main Laboratory

During the visit various aspects of work in progress in the laboratory were demonstrated, among them being the use of a large liquid scintillation counter for measuring the number ($\bar{\nu}$) of neutrons emitted in the fission of some heavy isotopes. A $\bar{\nu}$ bar value has been determined thus for U235.

The counter is filled with a liquid scintillator loaded with 6 per cent cadmium. A beam of neutrons is passed through a thin film of the material under investigation

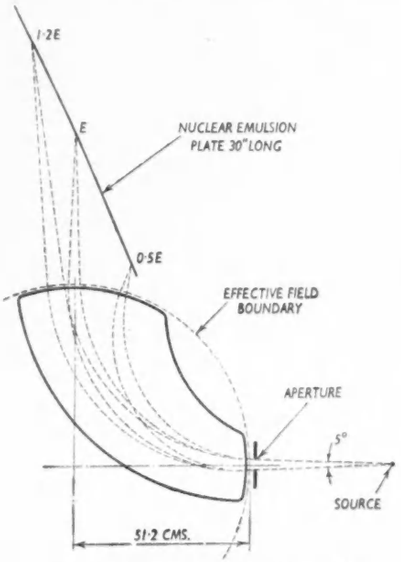


Fig. 6—Magnetic particle spectrograph

and the fission pulses produced are amplified and made to open the gate to an electronic pulse counter. Neutrons slowed down by the hydrogenous scintillator are captured by the cadmium, which then emits gamma rays. Eight 5in diameter photomultiplier tubes arranged in two banks observe the scintillator liquid, and only when both banks simultaneously see a scintillation is an output pulse produced. This coincidence system practically eliminates noise. The pulses are fed into the pulse-counter circuit for the duration of the gating time, and at the end of this time a pulse of height proportional to the total number of input pulses is fed to a pulse height analyser, which at the end of the experiment displays the number of times neutrons have been detected during fission.

Another investigation is the measurement of neutron energy by time of flight, a pulsed beam of neutrons being obtained from a target of the material under investigation. This target is placed at a known distance from the counter, at which pulses (corresponding to gamma rays from the target) are detected and the time interval from the emission of the target pulse is measured, and the velocity and energy are worked out.

Other Work

At the end of the visit Sir William Penney, Member of the U.K. Atomic Energy Authority for Weapons Research, Member Designate for Scientific Research, said that some fuel elements of an aluminium/plutonium alloy had been made at the establishment the first of which were on the point of being tested in "Gleep" at Harwell. The establishment had also played a part in finding out how to make components from beryllium, one of its activities being the development of techniques for welding this material. In the secret part of the establishment they had one of the best computing centres in the country, where work of importance to the Atomic Energy Authority had been done on subjects such as heat flow in graphite and the calculation of various complicated problems of neutron distribution around fuel. They would soon be operating a low-power reactor which would provide a very intense beam of neutrons and facilitate experiments on seeing how materials behaved when subjected to neutron bombardment. The new tandem accelerator would permit experiments on the interaction of nuclei in an energy range which could not be covered previously and would make it possible to disintegrate heavier elements such as plutonium and uranium.

Carron Company's Bicentenary

Two hundred years of continuous operation as ironfounders and engineers have now been completed by Carron Company (the definite article has no place in its title!), at Falkirk, Scotland. During the recent bicentenary celebrations, we heard much about the company's history and were able to see some of its present activities.

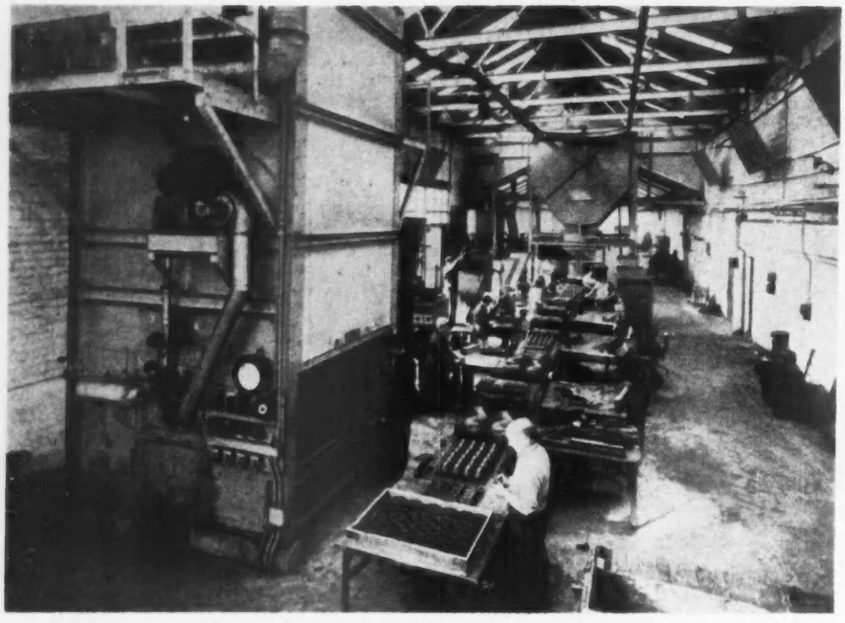
THROUGHOUT two centuries, Carron Company's headquarters have remained on the banks of the River Carron. They have steadily expanded on and around the site where, in 1759, two Englishmen, John Roebuck and Samuel Garbett, and a Scot, William Cadell, agreed to plan an "extensive manufactory of iron." John Roebuck was a Birmingham doctor who relinquished his medical practice to develop his interest in industrial chemistry and particularly in the production of vitriol; Samuel Garbett was a Birmingham merchant who shared Roebuck's enthusiasm for the vitriol making project, and William Cadell, of Cockenzie, had for some time been interested in the idea of establishing an ironworks in Scotland.

These three men, the original partners of Carron Company, went ahead with their plans. The 14-acre site which they acquired on the banks of the River Carron had most of the essentials. Nearby, there were deposits of ironstone, limestone and coal. Goods could be transported by river to the sea, and communication by "land carriage" to Glasgow, it was declared, opened up business prospects in the American market. Contracts were completed for obtaining ironstone and coal from neighbouring estates and a plant was built which included "four blast furnaces, four air furnaces, one double forge and two other forges, one boring mill and one slitt mill." To set up such a plant 200 years ago was no mean undertaking. The Carron dams had to be constructed to provide water power and, as Scotland was industrially undeveloped, practically everything for the foundation of the works had to be brought by sea. An example quoted in the excellent bicentenary publication, *The Story of Carron Company*, recalls John Roebuck's difficulty in sending north the necessary hearth stones for the furnaces and of his struggle to get an axle tree made for the furnace blowing equipment. A shaft 27ft long and 2ft 6in diameter was required but, finally, the partners had to make do with a smaller axle tree shipped from Bristol from where firebricks and clay also had to be sent. The complete cargo was a weighty one and the ship's captain made it plain that he could only go down the Severn if there was enough rain to raise the water level. After three days he claimed that there had been no rain and therefore he could not sail. Anxious to have the materials sent with all speed from Bristol, the Carron partners complained vehemently, "we have been sadly imposed upon by this Captain Hay who is a drunken fellow and a mean scoundrel. He actually hid himself three days to gain three days' more demurrage."

But fourteen years after the original partnership started, these initial obstacles had been overcome and Carron Company was recognised as a "Body Politic" under a Royal Charter granted by George III. For many years, one of the company's main activities was the production of cannon and shot, the principal customer for which, of course, was the Government. This fact may well have had some influence on the granting of the Royal Charter of 1773, which said *inter alia* "That the introducing and establishing considerable iron works in that part of Great Britain called *Scotland*, being of no less public utility than national advantage, by giving employment to some thousands, and, by extending the exports of Great Britain to Russia, Sweden, Denmark and many other foreign countries, although too great an object for any single person, yet was thought a proper one for a certain number of persons to engage in; a number of gentlemen, therefore, associated, and advanced in partnership, a capital sum of One hundred and thirty thousand pounds, and bound themselves to increase the same occasionally to the sum of One hundred and fifty thousand pounds; and they have carried on an iron manufacture thirteen years, under the name and title of CARRON COMPANY."

The company thus became established as a co-partnership and the rules and regulations laid down by the Charter are essentially those by which the company's affairs are conducted now. The direction of the company, for example, is the responsibility of the "standing committee of voting partners," which approximates to a board of directors.

Mention has already been made of the company's ordnance work. A product for which it was famous in the late eighteenth and early nineteenth centuries was the "Carronade," an example of which can be seen at the Tower of London. The "Carronade" was a naval gun which "threw spherical projectiles" of varying weights. The barrel was mounted on a wooden carriage running on four small wooden wheels and the breech end of the gun was supported on a wooden wedge; to lower the muzzle, the breech was raised with handspikes and the wedge pushed in to prevent it from dropping. A vent carried a train of gunpowder from the touch-hole at the upper part of the breech and when the gun was fired the muzzle protruded only a short way out of the porthole. The recoil forced it inwards about its own length,



Part of the modernised core shop at the Mungal foundry

when it was stopped by thick ropes fixed to the vessel's sides. To bring the "Carronade" into action again, men worked a tackle of ropes and pulleys which trained it to the porthole. The gun's only sights consisted of a deep notch on the muzzle and the angle for firing could be adjusted by marks on the wedge which corresponded with different elevations.

In its 200 years, Carron Company has been responsible for many other notable products. The cylinder for Watt's first engine was one of them, and a marine steam engine for William Symington was another. The building of the latter was supervised, in 1788, by Symington himself; the engine had two cylinders, 18in diameter with a 36in stroke. Actually, the engine was kept at Carron for the succeeding thirteen years until it became the prototype for Symington's "Charlotte Dundas." Adam fireplaces came from Carron as did numerous items listed in the early nineteenth century as "Ironmongery." Then, too, there was equipment for "dying and aquafortis works, sugar works, engine and salt works, husbandry and utensils for forges." In the list of products, classified as "goods for exportation" there were mentioned French pots, Canada pots and kettles and grubbing hoes! The company had not been in existence long before, in addition to its blast-furnaces, it was operating forges for producing blooms of wrought iron for rolling in the slitt mills. The strands of iron turned out by these mills were required for nail making. In addition to the slitt mill at Carron, the company operated one at Cramond, near Edinburgh, in which neighbourhood nails were made for many years.

The progressive development of the Carron business led to the company taking a prominent part in the promotion of the Forth and Clyde canal. The company established a shipping line and was a pioneer in railway construction. A railway, known as the "old wagon road," was built, with iron rails, between Carron and Bainsford Basin on the Forth and Clyde Canal. Soon after the company completed its first century, it became evident to the management that an extensive programme of modernisation was necessary to meet the growing competition from industry on the continent. Between, approximately, 1873 and 1890, the original works appear to have been more or less rebuilt and a few years later the extensive Mungal foundry was constructed. To-day, the foundry is producing castings required for a variety of industrial and domestic articles. Recently, a modernisation programme has been completed; one of the accompanying illustrations shows part of the core making shop.

A point of particular interest on the occasion of the bicentenary is that Carron Company continues its tradition of making a variety of things! Its regular products include mine winding gear, cargo winches, ships' windows and galley equipment, fire grates, cookers, baths, Post Office pillar boxes and telephone kiosks. That list is by no means complete! The Carron blast-furnaces produce about 750 tons of iron a week, not all of which is used for the company's own manufactures. Again, as from its earliest days, there are still occasions when Carron Company undertakes development and experimental work. An up-to-date example of this nature is the prototype electrically-operated tractor-plough which is shown in our second illustration. Very little information about this unusual piece of equipment is at present available. It incorporates a 30 h.p. electric motor and a hydraulic transmission system. Power is derived by cable from mains electricity.

There is much that might be added to this review of the first 200 years of Carron Company. One outstanding feature is its large number of long-service employees. This was exemplified a fortnight ago when at the three "bicentenary banquets" which were given, the thanks of the guests were voiced respectively by a moulder with over fifty years' service, a general labourer with the same number of years, and a representative from the company's engineering department whose service now exceeds forty-six years.

Prototype tractor-plough powered by mains electricity. It incorporates a 30 h.p. induction motor and a hydraulic transmission system

Replica Strain Gauge

THE replica strain gauge provides a rapid method for making direct measurements of local strain in structures under static loading. The technique has been evolved by the Royal Aircraft Establishment, Farnborough. A pattern of very light scratches is inscribed on the structure under examination and replicas of the pattern are taken before and after the structure is loaded. Subsequent comparison of the two replicas under a measuring microscope enables the displacement under load to be measured and, hence, the elastic strains to be deduced. An accuracy of 0·005 per cent over a 0·5in gauge length is stated to be attainable; for measurement of plastic deformation, a gauge length of 0·01in gives adequate accuracy. There are claimed to be several advantages over existing methods. No serious restriction is imposed on the size or location of the structure, and no permanent attachment is made to it. The preparation of the scratch pattern and the making of the replicas takes only a few minutes, and the replicas provide a virtually permanent record. An accuracy of 500 lb per square inch is obtainable in calculating the stress, and single or multiple measurements of strain over a small area may be made with equal facility. Finally, the direction as well as the magnitude of the strains is shown by one pair of replicas.

An instrument based on this technique is being manufactured by Mullard Equipment, Ltd., Mullard House, Torrington Place, London, W.C.1.

LETTERS AND LITERATURE

Letter to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

AN ENGINEERING APPLICATION OF REINFORCED RESIN

SIR,—Mr. Morrogh's letter in your issue of March 27, concerning my article on reinforced resin main condenser water boxes, obviously carries the weight of considerable personal experience.

The value of a deposition of corrosion products on the interior of the tubes and tube plates of condensers is not questioned. In fact, the arrangement we have made to achieve this result is to employ a sacrificial electrode, which is supported on the inside of the manhole covers, so that it is easily accessible for inspection and replacement. In this manner it is possible to control the type of corrosion products that are present in the water, and the infusion of these results in no deterioration in the strength of the box. In addition, by earthing the wasting plates, the same measure of cathodic protection could be afforded, as in the case of an unprotected cast iron box, if this were deemed necessary.

The considerable interest in reinforced resin as a material for the construction of water boxes in the last few years appears to originate from the trend towards larger sets, and the resultant location of generating stations on coastal and estuarine sites. In these cases, water with a high oxygen content is encountered and the problem of graphitic corrosion increased. In the case, however, of sets drawing their cooling water from a recirculating system, from rivers or freshwater lakes, the decision as to which type of box to employ depends more on economics than on technicalities.

Finally, it is appreciated that the introduction of a new material of construction in such an important application is a considerable adventure, and therefore every care has been taken in design and manufacture.

J. C. NEWSON

Mendip (Chemical Engineering), Ltd.,
21, Cavendish Place,
London, W.1,
May, 29, 1959.

Book Reviews

The Industrial Cooling Tower. By K. K. MCKELVEY and MAXEY BROOKE. D. Van Nostrand Company, Ltd., 358, Kensington High Street, London, W.14. Price 90s.

THERE are at least two ways of writing a book. The harder way is to study the subject thoroughly and put down what you know personally from long experience, thought, testing, analysis or research in the literature, carefully acknowledging sources. The other, much easier, is to collect published information from all convenient sources, add some original photographs and join the whole together with odd bits of chat. The present work is of the latter kind. It covers the basic fundamentals, theory and construction, and also the economics of mechanical and natural draught towers as designed and built in the U.S.A. and Britain, with occasional Continental variants thrown in (in Continental units). The stress is generally on natural draught designs, though there is no clear division and often the argument jumps disconcertingly between American and British ideas without warning for the reader about the very different outlooks on the two sides of the Atlantic.

The book is beautifully printed on fine, glossy paper in very clear type, and the diagrams are particularly well produced, though few, if any, are original. Much of the subject matter is based on or directly extracted from published sources, the authors' own contributions being, so far as can be traced, rather unimportant. Regarded as a collection of extracts from published papers, the book is quite a remarkable piece of work in that it is very complete. It even has a special value, since some of the sources, having been published during the paper shortage, are no longer readily procurable in the original. In a few cases the authors have had to do some translation. The photographs and diagrams of cooling tower construction in different countries are also of interest. A beginner may thus find the book useful.

But more experienced readers will already have met much of the text elsewhere and may be irritated to find some of the facts, figures and opinions quoted mutually contradictory and even absurd. The book would be more valuable had more discrimination and co-ordination been exercised. Included in it are both science and the sort of folklore that passed for cooling tower technology until a few years ago. Opinions are quoted (though without quotation marks and sometimes out of context) which writers, indeed, held at the time they expressed them but which they now might wish to modify, as well as discussions of issues since pragmatically settled. An example can be made of carry-over. Quotations from papers of ten years ago suggest that credence can still be accorded to the condensation theory of rain-making, whereas in fact that theory has long been discredited. Since the time when those papers were presented, spray eliminators have been fitted in most towers, with the result that complaints of nuisance have ceased. The experienced reader will be surprised to find serious discussions of condensation openings (most of those which used to exist have been blocked up for years), of the belief that there is some inherent virtue in the hyperbolic shape, in particular in divergence above the neck, and of the legend that wooden cooling towers are particularly inflammable. No distinction is drawn between Californian Redwood (sequoia sempervirens), a highly resistant timber, and "redwood" (pinus sylvestris), i.e. common deal, the difference between which is as great as between salmon and rock salmon.

Apart from a beginner, it is difficult to see who else could usefully employ the book. Cooling tower manufacturers hardly need to read it and will not study the mathematics, since they do not use any, all design having become in fact empirical, even that of the shell. For those looking for practical guidance on choice of towers and tower economics, the book seems insufficiently reliable about modern practice, and cooling tower economics is surely more subtle than the authors' text would lead one to suppose. The rule suggested in the book that natural draught is uneconomic where the wet bulb is over 70 deg. Fah. is disproved at Madras and Ahmedabad, which have average annual day wet bulbs above this figure. There is mention of dry cooling towers, but not of the true air-cooled condenser which is in much longer and widespread use as an alternative to wet cooling towers.

As regards the meteorological data, that in Table VII(*a*) evidently is collected with air conditioning in mind rather than the design of cooling towers. It quotes "design conditions" for London, England, of 85 deg. Fah. dry bulb and 70 deg. Fah. wet bulb! These conditions might be expected on something like four days per year; but in 50 per cent of years neither figure will be reached, so they are quite inappropriate as a basis for cooling tower designs.

Finally, the statement in the preface that cooling tower developments in various parts of the world are "jealously guarded secrets" is ridiculous. The wealth of information upon which the authors have themselves drawn disproves the assertion.

Books of Reference

Handbook of the Petroleum Industry. Edited by G. Sell and H. A. Dossett. George Newnes, Ltd., Tower House, Southampton Street, Strand, London, W.C.2. Price 25s.—This book provides background information for those considering a career in the petroleum industry and for those already engaged in it, and contains authoritative articles upon the many facets of the industry from a number of contributors. These articles deal with the geology and origin of the oilfields, the history of the industry, and touch upon exploration methods and drilling. Oil resources, distribution and refining of petroleum are described, and various sections are concerned with such subjects as oil shales, tar sands, petrol from coal, oil as a fuel and chemicals from petroleum. Present uses and future prospects of oil are discussed as are careers in the oil industry, and the final section, which deals with the various companies forming the petroleum industry, is followed by a comprehensive glossary of petroleum terms.

"*The Aeroplane*" Directory of British Aviation 1959. Temple Press, Ltd., Bowling Green Lane, London, E.C.1. Price 30s.—The last edition of its annual work of reference published by what is now *The Aeroplane and Astronautics*, follows the pattern of its predecessors. It incorporates a biographical section, "Who's Who in British Aviation," with over 1650 entries drawn not only from the Commonwealth but other countries. The sections devoted to service aviation, civil authorities, commercial aviation, and other organisations are comprehensive and covered by an index. The part devoted to aeronautical training shows, remarkably enough, that postgraduate training in aeronautics is available at no university.

Books Received

Practical Metrology. Vol. III. By K. J. Hume and G. H. Sharp. Macdonald and Co. (Publishers), Ltd., 16, Maddox Street, London, W.1. Price 10s. 6d.

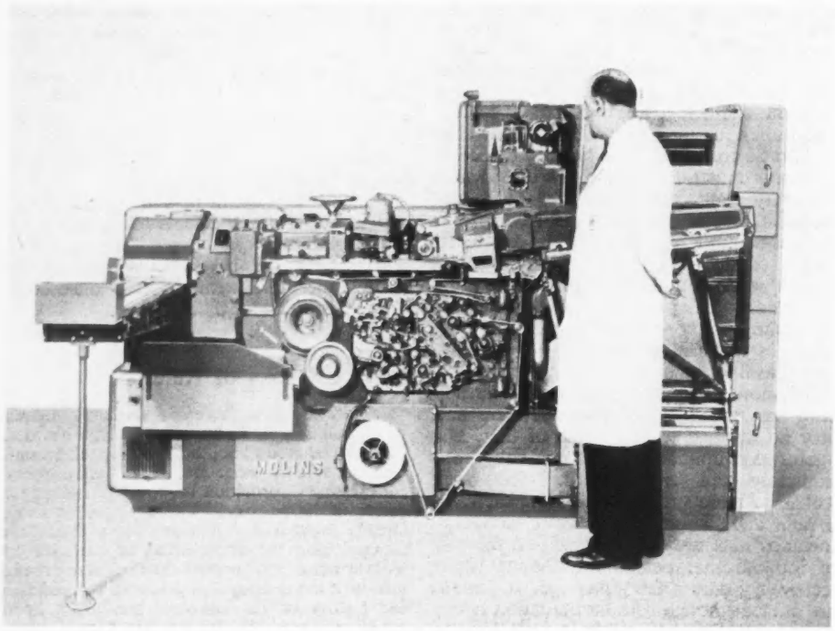
Watch and Clock Making and Repairing. Second edition. By W. J. Gazeley. Heywood and Co., Ltd., Carlton House, Great Queen Street, London, W.C.2. Price 42s.

Constitutional Diagrams of Uranium and Thorium Alloys. By F. A. Rough and A. A. Bauer. Addison-Wesley Company, Inc., 10–15, Chitty Street, London, W.1. Price 5.00 dollars.

Synthesis of Linear Communication Networks. Volume I. By W. Cauer. McGraw-Hill Publishing Company, Ltd., 95, Farringdon Street, London, E.C.4. Price 151s.

Cigarette-Making Machine

THERE was recently demonstrated at the works of Molins Machine Company, Ltd., Evelyn Street, London, S.E.8, an interesting new cigarette-making machine for which outstanding claims are made, and for which extensive orders have already been placed by manufacturers in this country and overseas. This Molins " Mark 8 " machine was demonstrated producing 1500 cigarettes per minute and tests on it are said to have shown that on Virginia tobacco the machine is capable of producing over 95 per cent of the individual cigarettes within ± 4 per cent of the nominal weight—as compared with 95 per cent within ± 7 per cent on the best existing high-class machines. This improvement is maintained on other kinds of tobacco. The makers state that on the basis of actual performance figures and the excellent " filling " qualities obtained by means of this machine, the nominal weight of the cigarette could, if desired, be set over 3 per cent lighter on the " Mark 8 " cigarette machine than on existing machines.



" Mark 8 " machine capable of making 1500 cigarettes per minute, 95 per cent of them within ± 4 per cent of the nominal weight

The " Mark 8 " machine can be seen in the photograph we reproduce on this page; its compact design is such that it requires only 60 per cent of the space occupied by earlier machines. In operation, tobacco is fed into the hopper at the upper right-hand corner of the machine, as seen in the illustration, by an overhead conveyor. From this hopper a system of carded rollers feeds the tobacco, separates it into its individual strands at predetermined controlled rates and impels the separated strands into a chamber at the base of the machine. From this point on, the tobacco is subjected to aerodynamic forces so arranged that tobacco particles impelled into the chamber are subjected to air streams which at first cause a separating action between the tobacco shreds and pieces of stems.

The stems gravitate to a waste box below, while the tobacco shreds are entrained in a high velocity air stream which carries the tobacco shreds up what might be termed a " chimney " mounted at the front right-hand side of the machine. Whilst moving towards the chimney, the tobacco shreds are carried past a perforated suction roller, which removes dust and fine particles according to its setting. The sequence then followed can be seen in the diagram we reproduce. At the top of the chimney is a continuously-driven perforated metal band through which the air is drawn and against the underside of which the tobacco is compressed and formed into a " filler " carried on the lower side of the metal band. The high velocity air stream impels the tobacco shreds at high speed towards the perforated band so that as they reach the band and build up on it, they are generally separate from one another. This in itself produces a filler of far more uniform structure and consistency than is made by conventional means. The air stream is also directed somewhat forwardly so that the tobacco shreds are enabled to be projected at high speed with a component of velocity in the direction of forward movement of the conveyor, substantially equal in speed to the conveyor speed.

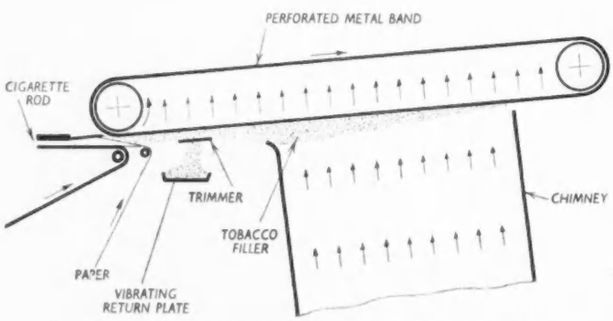


Diagram showing tobacco feed chimney and filler trimming section

The air suction is so arranged that at the outgoing side of the belt the density of the tobacco shreds is about two-thirds the density required in the final cigarette. Any fines and dust still remaining are carried through the perforations in the belt, thus leaving the tobacco shreds for forming the cigarette filler. The quantity of fines removed can be arranged to suit particular requirements. The tobacco carried by the belt moves through a narrow channel of approximately the same width as the final cigarette and as the belt carries the tobacco filler, still under suction control, beyond the mouth of the chimney, a trimming device in the form of contra-rotating wheels dresses the surplus tobacco down to the required depth to produce a cigarette filler of the desired cross-section. Tobacco removed by the trimming device falls on to a vibrating plate, whence it is returned to the supply hopper.

The cigarette paper is fed from a reel at the foot of the machine and passes up to the cigarette-forming section via printing rolls. At the end of the suction belt the trimmed tobacco filler is guided completely under control into a trough provided by the partially formed paper tube. It will be appreciated that at this point the metal band registers on its return roller, which provides a seal so that the suction of air holding the tobacco to it is cut off. The tobacco filler is, however, gripped between the paper and the suction belt during the transfer and thus cannot expand when the suction is cut off. From this stage the tobacco is shaped to final form and is enclosed and sealed in the paper passing along the machine bed, in conventional manner, through shaping, folding and pasting devices to emerge in the form of a continuous wrapped rod. As the tobacco filler has already been suctionally compressed to two-thirds the final required density, when it reaches the paper less mechanical work than on existing machines is required to form the filler into final shape and size.

At the end of the forming process the wrapped rod passes into a shearing mechanism which cuts the wrapped rod into cigarette lengths, which are then delivered to a catcher for manual collection, or an automatic catcher, as shown in the illustration.

An electronic weighing device is situated immediately before the shearing head and checks the weight of the wrapped rod as it passes through. This weighing device is coupled to the height adjusting system of the trimming unit adjacent to the perforated feed belt, and as any deviation is noted in the collective weight of the cigarettes the trimmer height is reset to a corrected position. Working in conjunction with this weight-correcting mechanism is a second system controlled by the suction of air through the perforated feed belt. In this second system a pipe connection from the chamber behind the belt actuates a diaphragm coupled to a hydraulic motor. When the depth of tobacco on the belt is too " high " or too " shallow " suction varies and the air diaphragm reacts to adjust the trimmer setting through the hydraulic motor. With these two automatic systems

working in conjunction a constant weight check is maintained and individual cigarettes can be produced, without operator supervision, continuously to the close limits of the stipulated weight previously mentioned.

Owing to the employment of aerodynamic means for feeding and forming and compressing the tobacco filler against the perforated metal band, it is claimed that not only are the filling characteristics uniform, but the uniformity of the drawing or smoking characteristics of the cigarettes is likewise superior to that of any existing machine.

The firm also demonstrated a new electronic equipment which has been developed for analysing the individual cigarette weight performance of a group of machines from a central desk. The panel of this desk contains a selector switch by which any one of up to thirty-five machines can be connected to the analysing equipment. The weighing unit on any machine selected by the switch feeds a signal containing information of the weight variation in each cigarette as it is produced. The equipment is capable of giving such signals at speeds of production up to 2000 cigarettes per minute. The analysing equipment sorts the weights into different categories, so that from the spread of weights in these categories the performance of the machines can be checked. Facilities are also provided for recording on a paper chart a continuous trace of the weight variation. The advantage of this equipment is that it enables the weight variation in 2000 cigarettes to be analysed in a period of minutes, whereas existing methods of checking would take hours, and then not show the variation of consecutive cigarettes.

Electricity and Standards of Living

The theme of the British Electrical Power Convention at Torquay last week was the contribution of electricity to the standard of living. In his presidential address to the convention, Mr. C. R. King outlined the history of the electricity supply industry in this country. The following abstracts from his address deal with the present structure and the problems and prospects of the industry.

THE principal provisions of the new (Electricity) Act of 1957 included the abolition of the Central Electricity Authority and in its stead the setting up of the Electricity Council and the Central Electricity Generating Board. The Council's constitution provides for a chairman and two deputy chairmen (one of whom is at present part-time), and not more than three members ; the chairman and two other designated representatives of the Generating Board ; and each of the twelve chairmen of the Area Boards.

The (at present) twenty members of the council guide the destinies of the entire supply industry in England and Wales. Policies of the supply industry will be determined by the Council and implemented by the individual Boards, but the Council cannot compel obedience to its decisions. In fact, each constituent Board has considerably more autonomy than that which had been enjoyed by the Area Boards under the 1947 Act. It was apparent from the outset that agreement would have to be reached around the council table, otherwise failure to reach agreement would have to be reported to the Minister of Power, who would then make the final decision. There were fears that the balance of representatives on the Council might create difficulties on issues of major importance. Happily, the last twelve months have shown these fears to be almost groundless, and so far it has been possible for the Council to reach unanimous decisions on all important matters. May that state of affairs long continue, because it would be little short of a tragedy if this great and enterprising industry could not resolve its problems within the family of the Electricity Council.

The Generating Board

The newly-formed Generating Board was a complete innovation so far as the industry was concerned, although it bore some resemblance to the old Central Electricity Board. Apart from the immediate vesting problems of deciding how the assets and liabilities and the staff of the former Central Authority were to be divided between the Council and the Generating Board, there were many new and difficult problems confronting the Generating Board.

First of all there was the inherited programme of new generating stations, both thermal and nuclear. Because of the increase in the capacity of new generating stations and the steady but pronounced increase in the size of individual units, it was anticipated that the future requirements of the entire industry could and would be met by providing four new generating stations each year, two of which would be nuclear. This was instead of seven or eight which was the average number of new stations commissioned by the Central Authority each year. Whilst there was every desire on the part of the Generating Board to keep all manufacturers fully employed and thus in a position to compete effectively for overseas business, there was bound to be some slowing down on the manufacturing side. To some extent this slowing down was aggravated by reducing to an absolute minimum the aggregate amount of plant to be kept available to meet the peak load requirements of short duration during the winter months.

During the previous ten years the Central Authority had based their programme each year on an estimate of 88 per cent plant availability, but the last two or three years had clearly indicated that average availability during peak winter months exceeded 91 per cent. After careful examination of all relevant facts, the Generating Board decided —and were supported by the Council—that a figure of 90 per cent availability was adequate. The adoption of this figure meant, of course, some reduction in the new plant programme and reduced still further the flow of orders to the manufacturers. From the manufacturers' point of view, this decision was most regrettable, but it was imperative in view of the vast amounts of capital which the Generating Board would have to spend on the already planned nuclear station programme.

Bulk Supply Tariff.—The second big problem facing the Generating Board was that of the bulk supply tariff. For the past ten years the bulk supply tariff had not reflected accurately the actual fixed charges attributable to generation and transmission and the actual running costs which were the basis of the unit charge. In other words, the tariff had become " tilted " and this tilt had been aggravated by the upward trend of capital charges and the downward trend of running costs, the latter being affected by the improved thermal efficiency obtained from the newer plant and by the larger units employed. So long as the tilt was retained in the tariff it was impossible for the Generating Board to offer to the Area Boards the full advantages of the lower unit running costs and thus enable the Boards to give their consumers the maximum encouragement for the improvement of load factor.

It was anticipated that by 1962 at least two of the new nuclear stations would be in commission, and as these stations would have relatively high capital costs and low running costs it was essential that they should be operated at as high a load factor as possible, even if this meant restricting the running of some of the fairly modern conventional stations.

With these and many other factors in mind, the Generating Board decided to put forward a new bulk supply tariff for 1959–60 containing an increased kilowatt charge and a correspondingly reduced unit charge. Thus every possible incentive would be given to the Area Boards to improve the national load factor by offering attractive tariffs for night and off-peak loads.

It remains to be seen whether financial inducements of this kind will, in fact, result in a sufficient improvement in the annual load factor. It is encouraging to note how quickly some of the Area Boards have responded by altering the shape of their tariffs to conform more or less with that of the new bulk supply tariff which came into operation only two months ago.

Changes in retail tariffs are closely linked with the future well-being and prosperity of the people. The heating of our homes and factories can readily be obtained from electricity bought at a low cost during night-time hours and stored for use during the day-time. More and more devices for doing this successfully are being invented every year, and it is not difficult to form a mental picture of a future era when such methods of heating will be commonplace in all homes and factories.

Transmission.—A third problem which is already causing the Generating Board considerable concern is the extensions necessary to the present transmission system and the siting of new lines. Work is still in progress on the planned 275kV Grid, but the rapid growth of generating capacity to deal with the ever-increasing load makes it essential for the existing Grid lines to be adequately reinforced. The siting of nuclear stations in remote places for reasons of safety necessarily means that long lengths of transmission line will have to be erected in order to transmit the energy to the industrial areas, and these lines may be erected in rural areas which have hitherto been regarded as unspoilt. Opposition to the erection of overhead lines is growing in volume, but the undergrounding of even small sections of these lines would be quite impracticable from the point of view of cost. A partial solution of the problem may be found after an early investigation into the possibility of stepping up the voltage of main transmission lines to 380,000V or even 400,000V.

This would add very considerably to the carrying capacity of future main transmission lines and especially those provided to transmit current from the new nuclear stations.

The Area Boards

Everybody would agree that the outstanding problem which causes the Area Boards most concern to-day is the legacy of those wartime years and concerns the inadequacy of their distribution systems.

During the last twelve years the Boards have been severely restricted on available capital. Reinforcement of overhead lines and cables has had to take second place to meeting the demand for new industrial and domestic supplies. New houses and factories have been erected at an ever-increasing rate and supplies to these have absorbed most of the finance which could be made available. Many Boards have had to replan their distribution networks in order to meet the growth of new business and, in consequence, the Boards have had little available money to deal with such pressing problems as standardisation of frequency and voltage, conversion of d.c. supplies to a.c. and the replacement of switchgear of inadequate rupturing capacity. All Area Boards are only too conscious of these problems, and are already tackling them energetically within the limits of the available capital.

It is of vital importance that all Boards should know how much new capital can be made available to them in future years. One realises that financial stringency has made a series of capital cuts essential from the point of view of the nation. But generating stations and transmission lines have to be planned at least five years ahead of requirements and distribution systems at least three years. Once the contracts have been placed and work commenced it is virtually impossible to call a halt to the spending at short notice and the burden of such cuts has to be borne by short-term projects many of which are only short-term because of their urgency.

Bearing in mind the difficulties experienced in past years, it is abundantly clear that Area Boards and the Generating Board cannot rely upon the National Exchequer to provide the same high proportion of the new capital which will be required in the years which lie ahead. More and more of this money will have to be found from within the finances of the industry, and the desire will be to try to do this without making startling increases in the retail tariffs even though, compared with other commodities, such increases are fully justified. It is clear from the results of the last eleven years that the productivity of the industry as a whole has been steadily increasing.

If this increase continues, as we have every reason to believe it will, it should be possible to apply this productivity increase, in part at any rate, to meeting the demands of self-financing. But Area Boards will have to take steps to ensure that their selling organisations are second to none if their rate of growth is to be maintained at the present high level. Competition from oil is a very serious factor to-day, especially in the field of heating. In fact, we may be moving back to the conditions in the 1920s when undertakings had to concentrate upon selling and selling hard in order to live.

Electricity's Contribution to the Standard of Living

In the 1930s, and even within the last ten years, there were large areas of rural territory without any supply of electricity—or gas for that matter. As the uses of electricity in the home and on the farm were developed, so the absolute necessity of affording supplies to all within reasonable reach became desperately urgent. Farming is still one of the greatest industries in the country and it had become almost impossible to keep men employed on the land without providing for them the facilities—of which electricity and water are the most important—which are regularly enjoyed by the town dweller.

The Central Authority and Area Board chairmen were fully alive to this serious problem, and, in 1953, at a conference held at Moretonhampstead, they produced a five-year plan which had as its principal aim the provision of supplies to farms and rural dwellings at such a rate as would ensure that, for the country as a whole, more than 85 per cent of such premises should have supplies connected by 1963. The relevant figures are given in the table and are worthy of study. They show that in fact the Area Boards are ahead of their original programme despite several periods of financial stringency which threatened at one time to bring the programme to a halt.

Imagine what this means to the comfort and wellbeing of those who work on the land and perforce must live in remote places ! Imagine, too, what it means to the farmer who is still beset with manpower shortages, but can now, to a considerable extent, replace physical labour with electric motors. No one can deny that the country dwellers of to-day are enjoying better living standards than those available even twenty years ago, and the extended use of radio and television has brought the town and country dweller into a much closer relationship than existed before the benefits of electricity were made generally available in rural areas.

It is true that there are still some areas awaiting electricity supplies and the future programmes of Area Boards will deal with most of these. But the back of the immense task has been broken and it is now up to the Area Boards, with the assistance of the National Farmers' Union, the Electrical Development Association, the Electrical Association for Women, and other organisations, to educate and instruct the farmer and small-holder in the manifold advantages which electricity can confer. Although many of the original rural schemes appeared at the outset to be financially unremunerative, the rapid growth in the sales of units in these areas clearly indicates an immense field for development and a future contribution to the problem of improving the load factor, to which reference has been made previously in this Address.

The market for electric cooking is still largely untouched because of the effective competition of gas cooking, and here we have a field for development which, because of the high factor of diversity, can make a real contribution to that higher load factor which will be so essential to our future development and efficiency.

One has heard the word "saturation" mentioned, but every year sees new uses for electrical energy and new devices which require electricity in still greater quantities. There are still many fields of development largely untouched. We are now living in a new age of automation, and industry, with the help of electricity, is adapting itself to the new techniques which reduce the amount of physical effort. More and more horsepower is being placed at the elbow of the factory worker, but there is still a vast field of development in the industries of the country. The British Transport Commission have started a huge programme of railway electrification which, within the next five years, will impose a greatly increased load on our transmission and distribution systems.

Better lighting in the homes, in the factories and offices, and, above all, in the streets and highways, is an urgent need for the future. The uses of electricity for industrial and domestic heating are only just beginning to be realised and appreciated despite the fact that there is nothing which could make a greater contribution to the elimination of the smoke nuisance. Further developments in the techniques of floor warming, carpet heating and space heating generally will undoubtedly ensure substantial increases in the uses of electricity in this field.

Rural Electrification in England and Wales, 1948-1958

Area Boards	Estimated number of farms in area*	Numbers of farms connected at :		Percentages of farms connected at :	
		April 1, 1948	December 31, 1958	April 1, 1948	December 31, 1958
London	82	81	82	98·8	100·0
South Eastern	12,500	5,557	10,232	44·5	81·8
Southern	25,776	8,015	21,903	31·1	84·9
South Western	30,076	6,330	19,264	21·0	64·4
Eastern	31,600	9,898	24,594	31·3	77·8
East Midlands	26,700	11,433	24,291	42·8	90·9
Midlands	26,600	7,779	20,974	29·2	78·8
South Wales	23,500	3,016	12,357	12·8	52·5
Merseyside and North Wales	33,400	8,810	21,811	26·4	65·3
Yorkshire	21,737	8,393	19,038	38·6	87·5
North Eastern	18,838	4,227	14,108	22·4	74·8
North Western	24,819	13,004	20,542	52·4	82·7
Totals	275,628	86,543	209,196	31·4	75·8

Date	Number of farms connected	Percentage of total farms
April 1, 1948	86,543	31·4
April 1, 1953	132,000	48·0
April 1, 1958	200,689	72·8
April 1, 1959	212,200*	76·9*

* Estimated figure.

The national target is the connection of 85 per cent of all farms by March, 1963, but the rate and extent of development differ between Areas according to local circumstances. Where farms are particularly remote and isolated, as in Wales and parts of South West England, difficult and costly supply problems arise, and it seems probable that a longer period will be required to complete the programme.

Strain Gauge Developments.—The latest issue of *This is Napier* describes some of the work done at the Napier research facilities on improving the performance of the resistance strain gauge, particularly in overcoming limitations in respect of temperature. No conventional cement would allow gauges to be operated above 600 deg. Cent., but satisfactory performance at 1000 deg. Cent. was attained by sticking the bare wire on to a vapour or shot-blasted specimen with flame-sprayed alumina : this means that gauges can be applied to virtually any metal component. To eliminate the problems of temperature compensation, which have led to a 100 per cent excess of gauges taking up space on the specimen at points not, in fact, at precisely the same temperature as the operating gauge, there has been developed a self-compensating gauge which includes a thermocouple and which responds only to stress over wide ranges of temperature. These gauges have been used to investigate the stresses imposed by heating and cooling on engine and alternator components.

Wood Chip Board Plant

RECENTLY a new wood chip board plant was officially opened at the Weybridge factory of The Airscrew Company and Jicwood, Ltd. This plant, the design of which is the result of careful research and investigation of existing processes in many countries, is expected to increase the production of "Weyroc" by about 50 per cent and also produce a board which is lighter and of higher quality. The new equipment replaces the old man-made timber plant, which consisted largely of converted machinery and had seen twelve years' continuous service. The changeover, necessitating the resiting of production lines and the erection of new buildings, has been completed without interrupting production. In the old system the process was lengthy, by reason of the large number of manual operations involved, whereas the new system consists of a closed-circuit conveyor line with the machines controlled, at speeds and temperatures predetermined by product requirements, from a central panel.

At Weybridge "Weyroc 38" will be manufactured from industrial wood waste, while "Weyroc 34" will be produced at the company's Annan factory from coniferous forest thinnings, the respective outputs being 20,000,000 and 15,000,000 square feet of board per annum.

Raw material, consisting of soft wood industrial waste from joinery works and timber mills in the Greater London area and poplar peeler cores and veneer waste from the Bryant and May match factory at Bow, is delivered to store. The industrial waste is fed into hammer grinding mills for reduction to chips of a standard size, while the wood from the match factory is passed through a chipping machine before entering the grinding mills. The chips are fed to storage silos and later are dried to a low and uniform moisture content in rotary driers using a steam-heated, hot-air stream. A full description of the drying equipment appeared in the February 14, 1958, issue of THE ENGINEER. The two raw materials are conveyed pneumatically through weighers to the mixing section. Here to the weighed quantities of chips are added measured quantities of resin adhesive to provide a uniform mixture, and each batch mix is passed to a surge bunker. The purpose of the latter is to ensure a continuous flow to the spreaders should there be a stoppage of any or all of the previous operations. From the surge bunker a Redler conveyor transfers the prepared chips to the board plant, which is laid out on a closed-circuit system. One of our illustrations gives a general view of the plant, including the spreader and the unloading end of the main press, while the other shows the prepress and the loading end of the ten-daylight press.

PRODUCTION SYSTEM

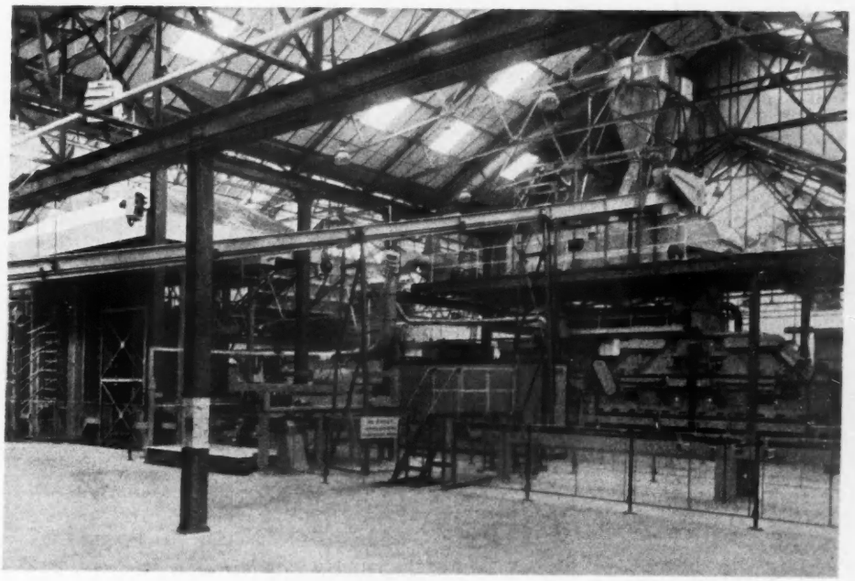
The mattress is formed on an aluminium magnesium alloy plate which is transferred across to the start of the process line by sections of chain conveyors, the last one of which is lowered, when a limit switch is operated, to place the plate on to idle rollers so that it can change direction through 90 deg. and be forwarded to the three-station chip-spreading machine supplied by Carl Schenck, of Darmstadt. A set of dogs moves the plate forward to a point where a cover plate forms a connecting link with the plate immediately ahead and covers the gap between successive incoming plates. In the spreader chips from the surge hoppers fall on to a short length of belting which feeds them to a throwing roller, which, by its action, grades the material as it deposits them on the plate. At No. 1 station fine to coarse material is spread, and at No. 2 station uniform material is spread, while No. 3 station handles the same material as No. 1, but throws in the reverse direction so that the composition of the mattress is balanced. After the deposition of the three layers to the required thickness the mattress passes through a cross-cut machine having a twin travelling parting saw which cuts along the lines of the cover plate. This then disengages and returns to the entry end of the spreader, while the mattress material on it is thrown off, collected and burnt.

The mattress is weighed, the weight being recorded so that adjustments can be made, if necessary, to the rate of feed to the spreader, and then a travelling shuttle draws it forward and also pushes the preceding mattress under a Becker and Van Hüllen prepress, where a pressure of between 100 lb to 150 lb per square inch is applied. A wire mesh suspended under the pressure ram holds the material in position while the ram completes its downward stroke. The same shuttle moves the mattress through the edge trimmer, and finally the mattress is transferred from idle rollers on to chain conveyors which deliver it to the finishing line.

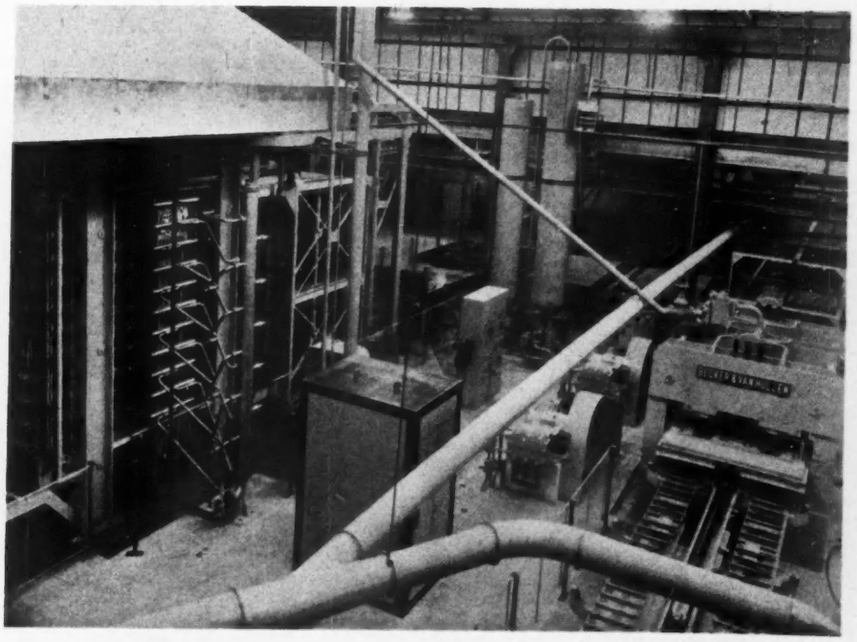
Each mattress passes through a fine water spray before entering one of the tiers of the ten-tier main press loader, where it trips a limit switch which causes the loader to rise one space ready to receive the next mattress. The mattresses are fed into a ten-daylight main press where a pressure of between 150 lb to 250 lb per square inch is applied, while steam at about 40 lb per square inch is supplied to cure the resin bonding. Residence time in the press, closing rate, temperature and pressure are all set according to the properties required in the finished board. The mattresses are withdrawn into the unloader from which they pass, one at a time, to the take-off machine, where the board is lifted off the plate by suction pad and transferred to a stillage. The plates continue in circuit and return to the spreader line. The cured boards are placed in a maturing store for controlled cooling and stabilisation of the moisture content

The whole plant is automatically controlled from a central panel which provides for fully automatic control, group control, or individual control. Speeds of the various operations are all collated and preset and the rate of supply of material adjusted to give required thickness of board.

In the finishing line the rough board is edge trimmed and cut to length in a machine supplied by Thomas White and Sons, Ltd., and conveyed to a Jonscreds three-drum sander where the top face is polished. Afterwards, the board is turned over, by pneumatically operated clamping arms, on to another polishing line, where the other surface is polished.



Chip board plant with spreader to the right and main press with unloader on the left



The prepress is shown on the right and main press loading arrangements to the left

SHORTER REPORTS

Mining Machinery Exhibition

THE latest products of nearly a hundred firms are to be shown at the Mining Machinery Exhibition, organised by the Council of Underground Machinery Manufacturers, which will be opened by Lord Mills at Olympia, London, on Thursday, July 9 next. This exhibition will provide mining engineers from this country and overseas with an opportunity to see the considerable amount of development which has taken place in plant of all kinds since the last exhibition held in London some ten years ago. Although the exhibition is primarily concerned with coal mining machinery there is also to be displayed a range of associated plant used in mineral mining, quarries and in civil engineering. Amongst the machines will be included a number which have been specially evolved for mines overseas where the conditions and requirements differ from those in this country.

A large number of visitors from abroad are expected at the exhibition as other countries have been showing a steadily increasing interest in the mechanisation and development work carried out in British mines during recent years. This point was emphasised at a recent luncheon by Mr. A. Yorke Saville, the president of the Council of Underground Machinery Manufacturers. He said that during the last ten years everything possible had been done by the manufacturers to make the mining industry of this country the best equipped and most efficient in the world. The markets for British mining equipment established long ago in Commonwealth countries had continued to grow and successful results had been achieved in other countries. The exhibition, he said, provided a means of showing potential customers the achievements of the industry by assembling a representative display of plant under one roof and giving them an opportunity to discuss points of interest with specialist manufacturers.

Concurrently with the exhibition the Institution of Mining Engineers is to hold a symposium on shaft sinking and tunnelling on July 15, 16 and 17. At this symposium papers are to be presented by engineers from twelve countries and representatives from thirty-three countries are expected to attend.

New London Suburban Diesel Trains

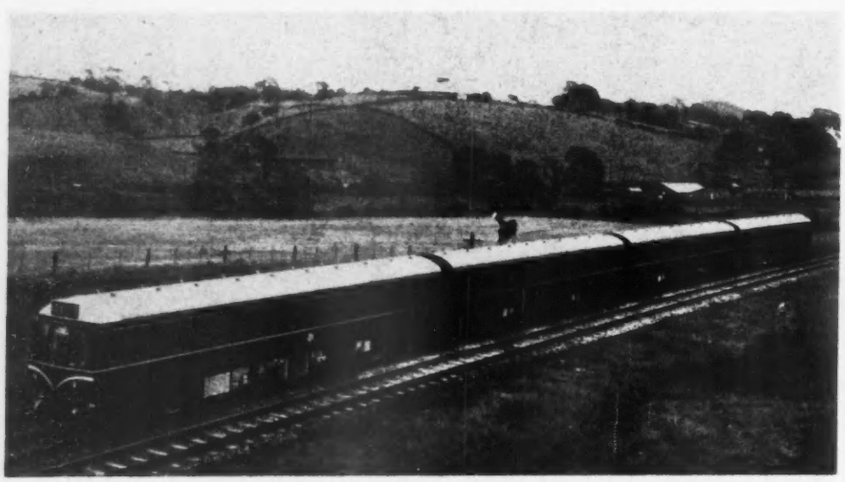
THIS autumn the first units of a series of thirty diesel trains being built by the London Midland Region of British Railways at Derby will begin running on the St. Pancras–Bedford local service. At this stage the diesels will share the workings with the existing steam trains, and will run to steam service schedules, but by January 4 next year they will have replaced the steam service completely and will run to faster timings and more frequently. It is hoped to improve the present journey time by local train between St. Pancras and Bedford by about half-an-hour, and that between St. Pancras and Luton by some twenty-five minutes.

The diesel trains consist of four-coach units comprising a motor brake open second at each end and two intermediate trailer seconds. All coaches have centre gangways and are divided internally by one or more full-width partitions. Seats are arranged in twos and threes on each side of the gangway, and in sixes against the partitions. There is a total seating capacity for 352 passengers in a four-car unit. All accommodation is second class. Passenger doors are provided between each facing block of seats, there being seven a side in the motor coaches, ten in one trailer, and nine in the other trailer, which has two toilet compartments located one on each side of a short central corridor. In this vehicle doors for access to the toilet section are provided in the full-width partitions and so the number of transverse seats at the partitions is reduced to four. All details of accommodation were chosen after careful studies of passenger requirements and of the effects of future development in the suburban area served from St. Pancras.

Two Rolls-Royce 238 h.p., "C8NFH," eight-cylinder normally aspirated engines are carried under each power car and drive through Twin-Disc hydraulic torque converters to final drives (incorporating reversing gear) with a ratio of 2·97 : 1. An oil-operated clutch engages direct drive automatically at 46 m.p.h. when accelerating, and reconnects the torque-converter at 49 m.p.h. during deceleration. This is effected by electro-pneumatic control through voltage-sensing relays energised by the speedometer tachogenerator. Two train units may be coupled to form an eight-car train, or a unit may be operated in multiple with certain sets of other makes having four-speed mechanical gearboxes. At the driver's right-hand, therefore, a four-position handle is fitted for remote control of gear-changing, and the speedometer dial is marked in sectors to show where changes should be made. The throttle control, on the driver's left, varies the engine speed in five steps. "Loudaphone" communication equipment is provided for communication between driver and guard, and in each cab there is an emergency brake handle which may be operated by the guard when assisting a driver at the other end of the unit during shunting movements.

The trains have fluorescent lighting operated on 240V a.c. from the 24 d.c. battery supply through 40W transistorised oscillators of types now being supplied to British Railways by The General Electric Company, Ltd., and Associated Electrical Industries, Ltd. This principle of conversion was first used on British Railways by the London Midland Region when certain first-class compartments in rolling stock of the "Caledonian" express were equipped with prototype units supplied by the G.E.C. Heating is by Smiths oil combustion heaters with thermostatic control. Armstrong shock absorbers are fitted for bogie bolster control.

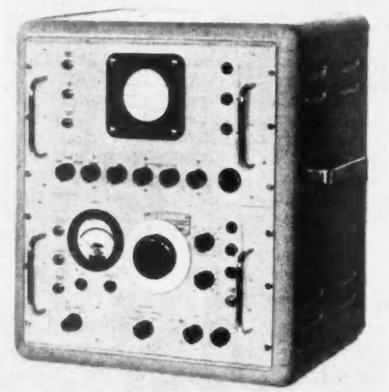
A four-coach train of the new rolling stock weighs 139 tons and measures 268ft 4in overall. Maximum speed is 70 m.p.h. Fuel tank capacity is 95 gallons per engine, giving a range of approximately 500 miles.



Four-coach, 952 h.p. diesel set with torque-converter transmission for London Midland Region outer suburban services between St. Pancras and Bedford

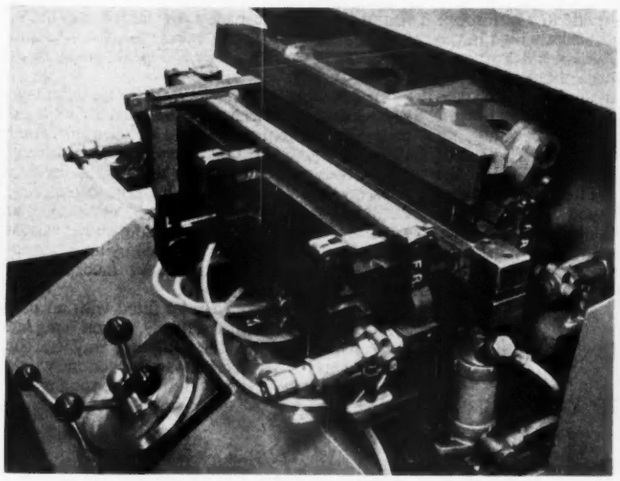
Signal Spectrum Analyser

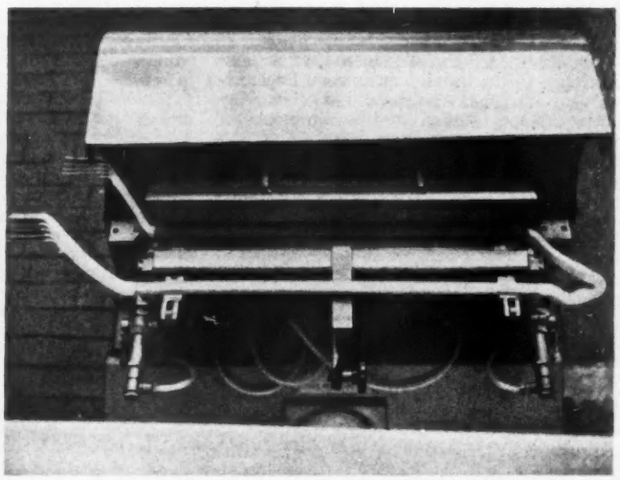
QUALITATIVE or power distribution analyses of simple or complex signals in the range from 500 c/s to 90 kc/s, such as those in carrier communications systems is effected by a new spectrum analyser of which we have received details from James Scott and Co. (Electrical Engineers), Ltd., 68, Brockville Street, Carntyne Industrial Estate, Glasgow, E.2. For rapid qualitative analyses the spectrum is displayed on the 4in oscilloscope screen seen in the illustration. The



Analyser for spectrum display and power measurement of signals or noise from 500 c/s to 90 kc/s

two sweep ranges provided are 500 c/s to 7 kc/s and 500 c/s to 100 kc/s. In order to analyse power distribution at any part of the spectrum, a marker blip produced by a manually-controlled oscillator with its dial calibrater in frequencies is lined up with the section to be studied. The manual oscillator setting now determines the centre frequency at which the measurement is made, and a bandwidth of 70 c/s or 1 kc/s is selected. Calibrated attenuators are then adjusted to give a constant reading on the thermocouple milliammeter seen on the front panel in the accompanying illustration. The attenuators read the signal power level with reference to a 40 microvolt calibrating signal at 10 kc/s. Single-frequency or noise signals may be measured at levels down to at least 1 microvolt. The maker quotes an accuracy of ±2dB at frequencies from 500 c/s to 90 kc/s. Measurements can be made at higher frequencies by the use of a superheterodyne receiver having a minimum I.F. bandwidth of 100 kc/s.





(Left) Mechanism of silicone insulation wrapping machine for LT.100 motor armature bars. The various slides, rams and the 12-position non-reversible rotary operating handle can be seen. (Right) Armature bar of LT.100 motor in position after completion of the wrapping cycle in the silicone insulation wrapping machine

Mechanical Wrapping of Silicone Insulation

A PROCESS for the mechanical wrapping of silicone insulation around the armature conductors of railway traction motors has been developed by London Transport. The process is the outcome of experimental work on silicone insulation as described in our issue of April 11, 1958, page 528. It may be recalled that at that time London Transport, after preliminary studies, had decided to use a fully cured silicone-elastomer-impregnated glass wrapper (instead of half-lapped layers of silicone elastomer glass tape coated with a pressure-sensitive silicone adhesive) for the slot part of the earth insulation.

It was realised that it would be difficult to apply the silicone wrapper by hand without producing unevenly wrapped conductors, which would be difficult to fit into their slots. Accordingly, London Transport set out to design and build a machine to do the wrapping accurately and consistently. Such a machine is now installed at the Acton Works, where it is reported to be working satisfactorily.

The machine, which is illustrated here, is actuated by a system of cam-operated pneumatic valves, which work at an air pressure of 80 lb per square inch. These valves allow air to pass to cylinders, which operate a series of slides and rams horizontally and vertically to envelop the conductors in the wrapper. They are operated in sequence by the movement of a twelve-position, non-reversible rotary handle, which is attached to the end of the camshaft.

The sequence of operations is given below :

Operation No.	
1 and 2	Conductors are placed on a strip of the silicone wrapping material and positioned by means of horizontal and vertical rams
3	Horizontal rams are removed
4	Slides move upwards, enfolding the wrapper on the two sides and the bottom edge of the conductor
5	Vertical ram is removed from the top of the conductors
6 and 7	Horizontal movement of a slide folds one end of the wrapper over the top of the conductors
8 and 9	Horizontal movement of a slide from the other direction folds the other end of the wrapper over the top of the conductors and forms a lapped joint
10 ...	Vertical ram descends on to the top of the armature bar and consolidates this joint in the wrapper
11 ...	Slides move down vertically from the two sides and bottom edge
12 ...	Vertical ram on the top of the armature bar moves away

The wrapped armature bar is then removed from the machine for the final taping with white glass tape.

Several difficulties were met in the development of this technique, including that of finding a suitable silicone adhesive to retain the wrapper in position on the conductors until after the final taping. Eventually a satisfactory material (pre-coated with a silicone adhesive of the pressure sensitive variety) was produced by H. D. Symons and Co., Ltd., and work is proceeding using this material.

The motor selected for tests with silicone insulating materials was the LT.100 machine designed in 1938 and fitted to the " 1938 " tube rolling stock. A large number of these motors are in service and in the present context the design is basically similar to the latest traction motors. The LT.100 motor is a 168 h.p. (one-hour rating), 600V, four-pole machine. It has thirty-one armature slots, five conductors to each slot, and is wave round. The armature slot space factor is higher in this motor than in any other in service on London Transport's railways, and this fact ensured that, if silicone insulating materials were satisfactory on this type of motor, it would be possible to use them on others with a lower armature slot space factor.

Motors insulated in the way described are now being placed in service and their performance will be closely watched to determine the additional life span to be expected from this method of insulation using silicone materials.

High-Definition Photomultiplier

A NEW fourteen-stage photomultiplier tube designed specifically for use when exceptionally high definition is required in scintillation counting and nuclear radiation spectrography is now available in limited quantities from Mullard, Ltd., Mullard House, Torrington Place, London, W.C.1. The most important requirement of a photomultiplier intended for such work is that differences in transit times of electrons through the tube should be negligible ; otherwise, the tube will not accurately resolve extremely short signals received in quick succession. In the new tube, designated 56AVP, transit time differences under typical operating conditions are stated to be as low as 0·3 millimicrosecond—an improvement of about 100 times over normal types of tube. As a result, the width of the output pulse delivered can be as little as 2 millimicroseconds at half height, and the rise time of the same duration.

To achieve the foregoing results the 56AVP incorporates a specially designed input electron-optical system consisting of the photocathode, a focusing electrode, an accelerator, and a deflector plate. The photocathode is curved so that the path lengths to the first multiplier stage are approximately equal for electrons leaving any part of its useful area. The focusing electrode and the accelerator act to concentrate the electrons into a single, narrow path, and to compensate for inequalities in their initial velocities. The deflector plate directs the electrons on to ths first of the secondary cathodes. Uniformity of transit times is maintained throughout the tube by careful shaping of the secondary cathodes and by additional focusing electrodes, situated between each multiplier stage, which progressively narrow the electron beam from stage to stage, despite the rapid growth in the number of electrons. The multiplier incorporates opaque, silver magnesium secondary cathodes, and gives, under typical operating conditions, a gain of 10^8 or more, corresponding to an average cathode sensitivity of 50 micro-amperes per lumen and an average anode sensitivity of 5000A per lumen. Peak anode current is 1A, which is sufficient for direct use without further amplification.

Mineral Insulated Thermocouples

THE principle of mineral insulation is being applied to thermocouple production by British Insulated Callender's Cables, Ltd. The thermocouples consist of two dissimilar thermo-electric conductors, welded together at a point (the hot junction), embedded in highly compressed magnesium oxide insulant, and encased in a seamless, circular, stainless steel sheath.

When heat is applied to the hot end, a small voltage is generated and detected by a suitable measuring device with a compensating lead. This voltage is proportional to the temperature causing it and thus the meter can be calibrated to provide a direct temperature reading. The positive conductor is of nickel-chromium alloy and the negative conductor of nickel-aluminium alloy. They are available in standard overall diameter sizes of 0·122in and 0·060in, but intermediate sizes are also available. Other dimensions and particulars are tabulated below.

Main Particulars of Mineral Insulated Thermocouples

Size, overall diameter, inch	0·122	0·060
Radial sheath thickness, inch	0·012	0·006
Insulation thickness between conductors and conductors and sheath, inch	0·020	0·010
Conductor diameter, inch	0·020	0·010
Volume of each conductor per yard, cubic inch	0·0113	0·0028
Volume of sheath per yard, cubic inch ...	0·15	0·037
Volume of magnesia per yard, cubic inch	0·26	0·065
Resistance of T_1 conductor, ohms/ft	1·1	4·6
Resistance of T_2 conductor, ohms/ft	0·44	1·85
Minimum insulation resistance, megohms per unit.	100	

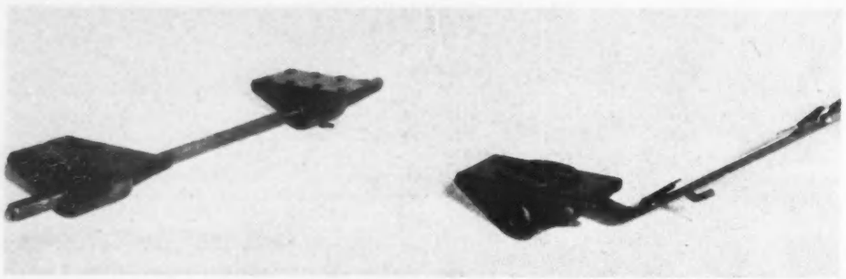
In the standard hot junction the conductors are welded together and the sheath is welded over to form a hermetic seal completely insulated from the conductors. This construction does not increase the overall diameter of the cable or make installation any more difficult. For the first time thermocouples of all sizes down to 0·060in diameter can be supplied with an insulated junction. At the cold end, a seal is fitted to prevent the insulant from absorbing moisture. The seal body is externally threaded to facilitate plain hole entry into junction boxes and instrument casings where it can be held in place by lock nuts. The cold end assembly will operate at temperatures up to 150 deg. Cent.

Mineral insulated thermocouples of the kind described have many advantages. They give rapid thermal response, since the small volume and high density of insulant offers excellent conductivity. They are available in long lengths up to 100 yards and with small overall diameters down to 0·060in if required. They are unaffected by high insulation resistance.

A recent addition to the range has been made possible by drawing on established cable manufacturing techniques. By laying up M.I. stainless steel sheathed thermocouples together with stainless steel strands, a multiple flexible thermocouple of small overall diameter and high tensile strength is produced.

Transporter Skates

We illustrate a recent addition to the "skates" developed by the Butler Experimental Engineering and Electrical Company, Ltd., 119, Hay Lane, London, N.W.9, for the movement of cases, machinery, &c., along floors. This particular equipment consists of two platform skates and one fitted with a turntable top and a hinged towing bar. The complete set, which weighs under 20 lb, can be used for moving articles weighing over a ton. It is used as shown; the two platform skates are coupled together in line to suit the width of the load by a bar passed through their hollow spindles. The turntable skate is positioned at any convenient point under the load in front of the platform assembly.



Two platform and one turntable towing skate as arranged for the transporting of articles weighing over 1 ton

The platforms and top of the turntable have upward projecting teeth to prevent a load moving on the skates when pulled along over an uneven surface. When the equipment is not in use the two platform skates can be clipped on the tow bar, and the set suspended from the handle in any convenient place.

This firm is now also making a simple design of rotator in two sizes for tubular and cylindrical articles. The small rotator handles work from 2in to 12in diameter and the larger model from 3in to 24in diameter. These rotators each comprise a box made of welded plate and having a "vee" formed down the centre of the side plates. The sloping sides of the vees have a series of slots cut across them and through their spindles rollers are supported in these slots. The rollers can be positioned in the slots along the vee sides in accordance with the diameter of the work to be handled.

22½-Ton Truck

A truck-mounted crane now made by Thomas Smith and Sons (Rodley), Ltd., Rodley, Leeds, has been introduced to meet the U.S.A. 25-ton (2000 lb) lifting capacity ratings. It has a maximum lifting capacity on British ratings of 22½ tons (50,000 lb) at 10ft radius when working with a 30ft basic boom, and 4·7 tons at 25ft radius with the 100ft maximum main boom length.

The machine is mounted on a six-wheeled special "Foden" truck with a heavy-duty chassis frame and its overall width has been kept to 8ft in order to permit unrestricted travel on public highways in Great Britain. The carrier has outriggers with screw jacks which can be extended to 13ft centres to provide adequate stability for heavy loads and high-lift work.

The truck is driven through a five-speed gearbox by a "Gardner" 5LW engine, developing 94 b.h.p. at 1700 r.p.m. as standard. A 6LW "Gardner" engine and an eight-speed gearbox can be fitted if preferred. The rear bogie of the chassis, both axles of which are driven, is mounted on substantial rocking beams with a third rocking beam to compensate for individual axle movement.

The revolving superstructure, on which are mounted the winch mechanism control gear and power unit, rotates on a large diameter live ring with twenty rollers, the tilting forces on the turret being taken by three adjustable hook rollers. A "Gardner" engine, developing 75 b.h.p. at 1500 r.p.m., provides power for the crane and the winch machinery, and controls are fully mechanical, separate clutches and brakes being provided for each motion. The structure frame is arranged to fold down to provide low headroom for travelling and yet to be sufficiently high in the working position to enable the 100ft main boom to be lifted from the horizontal without assistance.

The 30ft crane boom is made in two sections having pin joints and for it 10ft and 20ft pin-jointed lengthening sections are available up to a maximum length of 100ft. A boom head of semi-hammer-head construction simplifies the multi-strand rope reeving, and this design further improves the clearance between the boom and the load, especially at minimum radius when compared with an orthodox boom-head design. The boom suspension ropes are reeved on to a bridle which permits lengthening sections to be added to the boom suspension rope at the same time as lengthening sections are added to the boom. In addition to the 100ft boom, there is available a tubular design fly jib, having a basic length of 20ft and being jointed in the centre for insertion of lengthening sections. Additional equipment is available to convert the machine for duty as a two-line grabbing crane, pile driver, face shovel, back hoe and dragline. Capacity of the digging attachments is ¾ cubic yard.

Flameproof Circuit Breaker

A hand-operated air-break circuit breaker introduced by the Belmos Company, Ltd., Bellshill, Lanarkshire, completes a range of equipment designed to comply with N.C.B. specifications. The "SBU.1" circuit breaker (illustrated) is designed in accordance with N.C.B. Specification P 7/1950 and certified flameproof by the Ministry of Power under Certificate No. 4242 for Group 1 gases. The housing comprises a welded steel case divided horizontally into two flameproof compartments, the upper one containing a triple-pole on/off/earth isolator, and the lower compartment housing the circuit breaker and its protective gear. These items are mounted on a withdrawable chassis which can be removed from the enclosure on slide rails. The breaker is continuously rated at 200A and has been tested in accordance with B.S. 936 : 1940. It has a breaking capacity of 9000A at 650V, 0·25 power factor, equivalent to 10MVA, and a making capacity of 21,200 peak amperes at 650V.

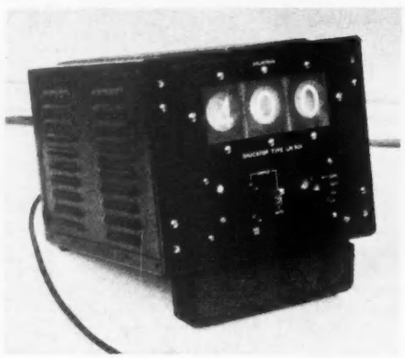
Flameproof circuit breaker, showing outgoing cableway and provision for coupling to a bank of units for busbar sectioning

In addition to overload and undervoltage protection, earth leakage protection is provided by a d.c. relay energised from a ring transformer through a full-wave rectifier; an intrinsically safe lock-out circuit ensures that, if the breaker trips because of an earth fault on the outgoing cable, the breaker cannot be reclosed until the fault is removed. Remote tripping and electrical interlocking can also be provided by an intrinsically safe remote control circuit incorporating pilot-earth fault protection.

The circuit breaker can be fitted with an outgoing cableway; alternatively, when coupled to a bank of units, the outgoing way can be omitted and the breaker used as a section switch, controlling the supply to the throughgoing busbars.

Digital Voltmeter

Direct readings in 1in illuminated figures and facilities for a printed record are provided in a new digital voltmeter, of which we have received details from the Solartron Electronic Group, Ltd., Thames Ditton, Surrey. The voltmeter, known as the Solartron "999," type 901, uses a transistorised circuit and measures 6½in high by 7¾in wide by 12in deep. The voltage range is from zero to 99·9V in three sub-ranges, or to 109·9V when using a range extension facility. Measured voltages may be monitored continuously, the reading changing with any variation, or sample readings may be taken at intervals by operating a sampling button, the display then remaining until the next sample is required. Figures are shown in white on a red or black ground according to polarity, discrimination being automatic. Information displayed may be printed-out or otherwise recorded by a connection to the rear socket, which provides an output of full decimal-coded information equivalent in value to that indicated by the display. The "sample" facility is also available remotely, using a remote switch or pair of relay contacts, and the main display may be located remote from the voltmeter itself, or two displays may be operated from one voltmeter unit.



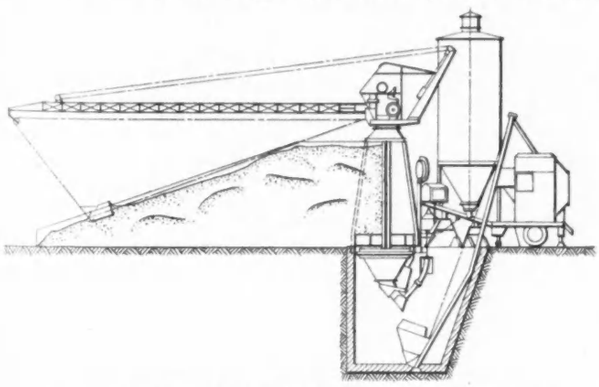
Voltmeter with display in 1in figures and print-out facilities

Figures are displayed by an optical projection system and, as seen in the illustration, are presented in one plane. The accuracy (absolute) quoted by the maker is ±0·25 per cent of maximum indication on all ranges, but this figure is governed by the long-term stability of the Zener diode used for reference. If the voltmeter is standardised against a Weston cell, a short-term accuracy of 0·1 per cent of maximum indication is stated to be possible.

Weigh-Batching Plants for Concrete

We have received details of a German system of weigh-batching for concrete, which has been introduced into this country by A.C.E. Machinery, Ltd., Porden Road, London, S.W.2. The basic modification which this system introduces is the elimination of the elevated aggregate bins normally associated with a large installation

for batching and mixing concrete. The accompanying illustration shows a typical arrangement from the range of plants in the system. A star-shaped storage area is set aside for the aggregates with a horizontal boom pivoted above the centre point, from which a scraper is operated to keep each size of aggregate heaped up against its outlet, which is also at the centre point of the star. Aggregate is discharged directly into a weigh-hopper, positioned in a pit as shown in the diagram. The weighed aggregates are taken by an elevator to the concrete mixer. Cement is taken from the silo and weighed by a device known as a "screw balance," which combines automatic weighing with screw conveying.



Arrangement of concrete plant of 59 cubic yards per hour capacity

Several alternative arrangements of the plant are possible, e.g. discharging into the aggregate weigher above ground level ; or weighing cement and aggregate into the aggregate hopper, and then elevating directly into the concrete mixer. Capacities of these plants range from 8 cubic yards per hour to 65 cubic yards per hour, with one, two or three men needed to operate them, according to the degree of automatic control built into the plant concerned, and the quality stipulated for the concrete. For larger outputs, up to 260 cubic yards per hour, a different arrangement is used, with the aggregates discharging into a conveyor in the pit ; for these large plants, one man is needed for the mixer, plus one for each scraper.

Performance of Handsaws

THE D.S.I.R.'s Forest Products Research report for 1958 has just been published. Amongst the various topics of research on which progress is recorded is a programme of investigation into the performance of handsaws. Details of this programme are reproduced from the report hereunder.

A testing machine capable of operating a handsaw under conditions approaching those found in manual use has been constructed. The machine consists essentially of two parts, a frame for holding the handsaw, which is pivoted at one end on two pairs of widely spaced parallel links, and a clamp for holding a timber specimen which is reciprocated by a crank and shaft on a rod placed under and parallel with the handsaw blade. In operation, the saw is lowered on to the reciprocating specimen of wood and cuts through it at a rate dependent on the counterbalance weights applied to the linkage system and on the angle that the links make with the horizontal. The machine is so constructed that the links are inclined slightly above and below the horizontal during the early and late stages of the cut respectively. This difference in their attitude ensures that the saw follows normal practice by cutting more heavily after it has become buried in the wood. An interesting feature in the operation of the machine is an electro-magnetic device which raises and disengages the handsaw teeth from the wood, as is normal practice in manual operation, during the return or non-cutting portion of the stroke. The performance of a handsaw fitted to the machine is assessed by counting automatically the number of strokes required to cut a certain depth of wood.

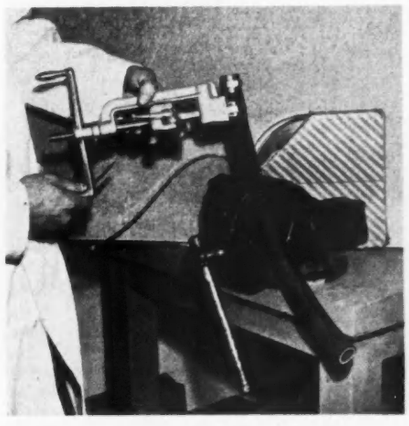
A programme of research planned to provide data on all the factors affecting the performance of handsaws is in progress. Experiments so far have been concerned with the effect of hook and bevel angles on ease of cutting and quality of sawn finish. Handsaws having six teeth per inch, with hook and bevel angles ranging from 5 deg. to 25 deg. and 10 deg. to 40 deg. respectively, have been employed for ripsawing and cross-cutting kiln-dried redwood and beech. In the cross-cutting of the redwood, an increase in hook and bevel angle caused an increase and a decrease respectively in the number of strokes needed to cut the same area of wood, but there was no practical difference in the performance of handsaws having teeth with 5 deg. and 10 deg. hook and 10 deg. to 40 deg. bevel angle. In the other experiments, the ripsawing of redwood and the cross-cutting and ripsawing of beech, the performance of the handsaws deteriorated with either increasing hook or bevel angle. The handsaw with 5 deg. hook and 10 deg. bevel always gave the optimum performance in both operations, but except in the ripsawing of beech, there was no great difference in saw performance having 5 deg. and 10 deg. hook with 10 deg. and 20 deg. bevel angle. An indication of the effect of hook and bevel angle on the performance of commonly used handsaws is given in the table. For the purpose of comparison the number of strokes needed by the saws with 5 deg. hook and 10 deg. bevel has been equated to 100 irrespective of the class of sawing operation and species of timber sawn.

Effect of Hook and Bevel Angle on the Performance of Handsaws

Hook angle, deg.		5	5	15	15
Bevel angle, deg.		10	40	10	40
Species	Operation	Relative number of strokes to cut a wood specimen of uniform size			
Redwood ...	Cross-cutting ...	100	100	135	110
	Ripsawing ...	100	266	152	713
Beech... ...	Cross-cutting ...	100	128	190	245
	Ripsawing ...	100	404	314	589

Tension Band Clamping Equipment

A LICENCE has been acquired by G. E. Simm (Engineering), Ltd., 27, Broomsgrove Road, Sheffield, 10, for the distribution in this country of the "Band-it" clamping equipment which has been successfully used in the United States for some time. This equipment consists of a tensioning tool by which a stainless steel band is fitted with a locking buckle and tightened on an object to any required degree within the strength of the band. The clamping bands are supplied and used directly from a long coil enabling work of any reasonable diameter to be banded without need for stocking various lengths of clamping bands. The system can be used for fastening metal couplings to flexible pipes, locking patches on split tubes, banding split wooden poles, bundling pipes and poles for transport, and many other applications where a permanent or temporary locking band is required.



Clamping tool fixing stainless steel band on hose

In the photograph we reproduce, a band is being applied to lock a coupling in a flexible hose. To fit the band, its end is pushed through a slot in the buckle and the required length passed round the object. The band end is threaded through the buckle, under the encircling length, and then doubled under the buckle to register between its underside and the pipe. The free length of band is slid into the two pairs of jaws of the tool from the side and the front jaws pushed up against the buckle. The rear jaws of the tool are then locked on the band by the swinging over of a cam lever. These rear jaws are glide carried on a screwed spindle so that as the spindle is turned, the free end of the band is drawn through the buckle to apply the tension, the front jaws meanwhile holding against the buckle. When the required degree of tension has been applied, the tool is swung over the buckle, whilst the tension is gradually reduced ; this operation locks the band on the work and a cutting handle on the front jaws is operated to shear the free band stock from the work. The length of band left by this shearing operation is pressed down between two ears on the buckle and these ears are hammered over to complete the clamp.

The stainless steel band used is supplied in 100ft lengths and in widths of $\frac{3}{8}$in, $\frac{1}{2}$in, $\frac{5}{8}$in and $\frac{3}{4}$in; for certain applications, both the buckles and the bands can be supplied in special steels or non-ferrous materials. When the tool has to be used in confined spaces it can be fitted with a tensioning nut in place of the handle or the spindle. If the tool cannot be swung over to complete the locking action in a restricted place, when applying the standard design of buckle, a buckle fitted with a locking screw can be supplied to hold the clamp after tension has been applied.

Ultrasonic Beer Fobbing

FOBBING is the process by which the air is expelled from the container immediately before stoppering to prevent deterioration of the beer during storage, and is conventionally done by mechanically tapping the bottles or, if the beer is in cans, by injecting carbon dioxide.

The ultrasonic process, in which the fob is induced by applying ultrasonic energy to the beer via the wall of the container is claimed to have several practical advantages over the conventional methods. A greater volume of air can be removed, and hence the storage life and quality of the beer enhanced. The amount of fob produced can be controlled more accurately, eliminating both underfilling and wastage due to overspill. Much higher filling rates can be achieved, and there is no risk of damaging bottles by impact or stress.

An ultrasonic beer fobbing equipment, known as the "Vibra Fob" has been developed jointly by George Hopkins and Sons, Ltd., and Mullard Equipment, Ltd., Mullard House, Torrington Place, London, W.C.1, and is at present undergoing trials at a well-known London brewery. The equipment produces a fob dense enough to reduce the air content in a container to as little as 1 milli-litre per pint, and is capable of fobbing up to 30,000 bottles or cans an hour. Its ultrasonic output is infinitely variable for adjustment to suit all conditions of temperature, pressure and carbonation, and to ensure an accurately maintained filling level.

The "Vibra Fob" is designed in unit form for easy integration with new or existing filling lines, and is sturdily built to withstand the rigorous conditions usual in bottling plants. The ultrasonic power unit is waterproof. Control of the equipment is effected from a remote unit incorporating both manual and automatic stop/start controls, the latter being coupled to the filling machine. The magnetostriction transducers are 20 kc/s, driven by a 60W ultrasonic generator operating from normal a.c. mains supplies.

Acoustic Ear Muffs

To provide effective protection for people who have to work in places where extreme noise is an unavoidable factor in operating conditions, the "Eargard" illustrated below has been developed by Denis Ferranti Meters, Ltd., Llangefni, Anglesey, in conjunction with British Industrial Plastics, Ltd. These ear muffs have cups of "D.M.C.," a special noise resistant plastic material, and these cups are mounted on a spring steel wire head frame on which they can be adjusted for fit by screw collets. A P.V.C. cushion partially filled with liquid provides an effective and comfortable seal between the wearer's head and the cups, and, as virtually no air is contained in this cushion, it can safely be taken to high altitudes without danger of bursting. A foamed polyurethane attenuation sponge in the cups may be removed and washed as required, and a piece of foamed polyurethane mounted on the frame forms a comfortable pad

"Eargards" for protecting the ears when working under conditions of extreme noise

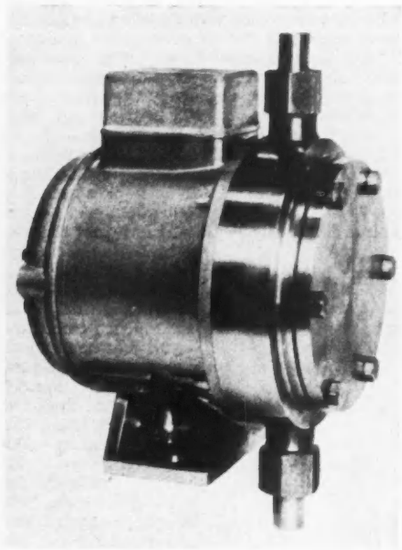
for the top of the head. All the metal parts, except the wire frame, are of anodised light alloy and they can be washed and disinfected without damage or loss of efficiency.

"Eargards" are also supplied fitted with compact transistorised receivers, which allow the clear transmission of orders from an induction loop system. For two-way communication, they can also be fitted with visor-mounted noise cancelling microphones. An "Eargard" fitted with an induction loop receiver may be used with a normal telephone hand set when it is held to the outside of the shell.

Totally Enclosed Leakproof Pump

THE small, totally enclosed pump illustrated here is made by Sigmund Pumps, Ltd., Team Valley, Gateshead, 11, for operation in cases where the nature of the liquid being handled demands that there shall be no leakage. It is made for a ½in branch, has an output of up to 8 gallons a minute and can be used for heads up to 60ft. The pump, which is known as the "Zero Leakage" pump, is constructed of stainless steel and is of "canned rotor" design whereby glands and mechanical seals are entirely eliminated. Its bearings are lubricated by the liquid being pumped.

The rotating element, mounted on a fixed stationary axle, is hydraulically and dynamically balanced to ensure smooth operation. The end cover is easily removed to give access to the rotating element, which can be withdrawn without breaking the pipeline joints and without interference with the electrical connections. The squirrel cage rotor is entirely shrouded by stainless steel, and the totally enclosed stator is suitable, in the standard design, for pumping



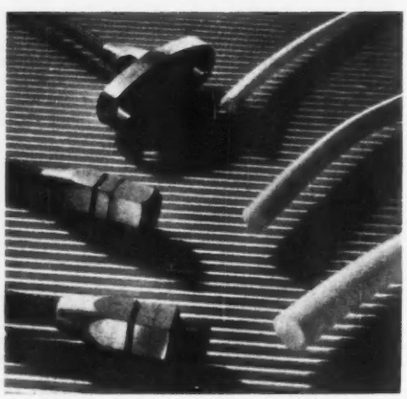
Totally enclosed leakproof pump

temperatures up to 260 deg. Fah. (127 deg. Cent.). Special windings are available to permit pumping temperatures from sub-zero to 400 deg. Fah. (205 deg. Cent.).

The pump is designed for foot mounting; in many instances, however, direct pipeline mounting is permissible provided the axle is kept in the horizontal plane.

Flexible P.T.F.E. Hoses

A FLEXIBLE hose of P.T.F.E. with an outer protective sheath of closely woven wire braiding is now made in standard sizes of ¼in, ⅜in, ½in, ¾in and 1in bore by William Rose, Ltd., Hilyn Works, Lockfield Avenue, Brimsdown, Enfield, Essex. This form of hose can be used with temperatures ranging from —80 deg. Cent. to 250 deg. Cent., and under certain circumstances will remain serviceable at temperatures up to 300 deg. Cent. Working pressures depend upon the bore size of the hose—a ¼in bore hose being suitable for a working pressure up to 5000 lb per square inch and a 1in bore up to 2500 lb per square inch. A simple re-usable coupling developed for use with the hoses is available in various metals, and forms of this coupling can be seen in the illustration below.



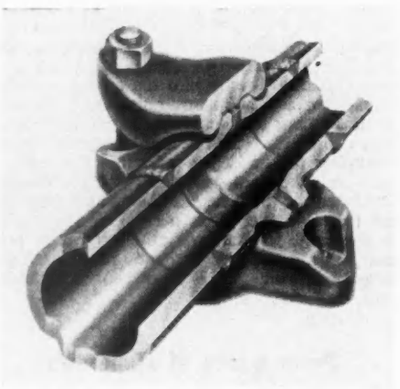
Flexible P.T.F.E. hoses and couplings

The maker states that the very low co-efficient of friction of P.T.F.E. provides rapid and smooth movement of a conveyant. The tubing is suitable for conveying most liquids and is resistant to most known acids and corrosives. Its "non-stick" properties make it useful for handling such things as dough, glues, resins, and paint, and the fact that P.T.F.E. is non-toxic and odourless within its working temperature range further suits the hose for use in the food and chemical industries.

High Temperature and Pressure Pipe Connection

A LICENCE has been acquired by Ruston and Hornsby, Ltd., Lincoln, from the Gray Tool Company, of the United States, for the manufacture in this country of "Grayloc" seals and connections for high-pressure and high-temperature pipe and other installations. The construction of a typical seal connection as applied to a pipeline can be seen in the photograph we reproduce below. In this particular case special hub ends are welded to the pipe ends to be coupled; in other applications the required hub form for sealing purposes can be machined on the components to be coupled together.

The seal member comprises a rigid ring, usually of a low-alloy chromium-molybdenum steel, made in the general form of a "T," the cross bar being provided by a pair of flexible tapered lips which seal in the bores of the mating hubs. The taper on the inner sides of the lips is slightly less than that in the bores of the hubs, and the straight stem of the seal registers between the faces of the hubs when the ring is in position. A two-piece clamp, having inclined shoulders in its bore, is made to register upon tapered flanges on the hubs. As the two parts of this clamp are drawn together by its bolts the tapered shoulders move down the hub flanges to draw the hubs



Sectioned "Ruston-Grayloc" high temperature/pressure pipe connection and seal

together on the stem of the sealing ring. At the same time the sealing element lips are deflected to a predetermined degree to conform to the tapers in the hub bores and provide a continuous, close-fitting, surface seal on the inside of the connection.

It is stated that in this joint the stored energy in the stressed sealing ring provides a sealing force capable of withstanding high pressures or vacuum. The rigid nature of the sealing ring prevents mechanical damage to the seal in the event of the bolts being over-tightened, and it provides a solid link through the connection. The tightening of the clamps is used only to pull the assembly together and the clamps do not carry any of the primary forces resulting from internal pressures in the pipe system. According to the makers, the ability of "Grayloc" connections to withstand high pressures results from the small diameter sealing area. As the seal is effected very near the inside surface of a pipe, there is a minimum axial separating force which is resisted by the clamp and hub construction.

When the connections are made in standard materials they are suitable for high-pressure service conditions and temperatures from −175 deg. Fah. to +1000 deg. Fah., and units made in various materials are available for higher or lower temperatures. The couplings are available as unions for use with pipes from ¼in to 1¼in bore, and the two bolt clamp connections described above are made for 1½in to 30in diameter pipes.

Industrial and Labour Notes

Conference on Standards

The one-day conference of engineers and others concerned with the application of standards in industry, which is organised each year by the Institution of Production Engineers and the British Standards Institution, was held on Thursday, June 4, in London. This conference, the fifth of its kind, was under the chairmanship of Mr. H. A. R. Binney. The opening address was given by Lord Halsbury, who said that managements should give every encouragement to standardisation within their organisations; he regretted that of at least a thousand firms in this country who should be interested in standardisation, only about 240 were represented at the conference. Only by effective standardisation could the introduction of an uneconomic variety of products be avoided in factories. Lord Halsbury considered that prices of non-standard products often unnecessarily requested by purchasers should be stepped-up to discourage their demands.

A paper presented by Mr. Bertram White on the subject of simplification in practice, described the steps taken by a large chemical manufacturer to rationalise and standardise an unwieldy and in certain cases uneconomic range of products. In a series of steps, manufacture of many products supplied infrequently in small batches was passed to other firms, and lines not common to the general range of products discontinued. Over a period, the actual number of products was reduced to about one-sixth of those originally made. Now the full capacity of the firm was concentrated on some 250 products, most of which were in continuous or large batch manufacture ; this enabled space and plant to be used to a greater degree of efficiency and a vast amount of paper work eliminated.

A draft of a booklet entitled " Operation of a Company Standards Department," was presented to the conference for discussion by Mr. S. T. Robinson, who was responsible for its preparation with the advice of a panel of an I.P.E./B.S.I. committee. This booklet is shortly to be published. Many points in the draft of the booklet were discussed and there were some criticisms about omissions. Mr. Robinson pointed out that the publication was intended as a brief guide, giving information not generally available, for standards engineers—not a full dissertation which would call for a fairly large book. It was evident that the general feeling at the conference was that the booklet would do much to assist standards engineers, particularly those introducing a standards practice in a factory.

Three reports were presented—one by the B.S.I. on the significant trends in recent standards work, one by the I.P.E. on the work of its standards committee, and a progress report of the I.P.E./B.S.I. joint standing advisory committee. The final subject of discussion at the conference was on co-operation between standards, design and purchasing departments in the application of standards. It was introduced by Mr. A. Parrish, who said that the problems it was intended to cover were those which arose in translating British standards into terms of purchasing specifications or the particular design required for an installation. The discussion dealt with means by which British standards could be made more readily usable as purchasing specifications.

Work Study Course

The City and Guilds of London Institute has devised a work study course which was explained at a meeting in London on Wednesday of last week. Mr. A. J. Speakman, chairman of the Institute's advisory committee for the subject, said that the course, it was envisaged, would normally be taken by students who had already obtained basic qualifications appropriate to their industry and who had followed a work study course in a technical college, institute of further education or works school.

The syllabus cover method study, work measurement and the applications of work study to manufacturing and non-manufacturing activities such as office work, transport and the retail distributive trades. There is also a general section covering such items as the factors and risks involved in industrial and commercial activities, the interrelation between work study techniques, the position of the work study practitioner in the management team, work study and industrial relations and future development and research trends in the field of work study and associated human sciences.

In addition to a written examination, candidates will be required to carry out a project which will be an investigation of at least one major activity employing the techniques of work study in a co-ordinated manner. There will also be a practical examination. To obtain the Institute's certificate in work study, candidates must pass the written and practical examinations and carry out the project satisfactorily. The syllabus will come into operation in September and the first examinations will be held in May, 1960.

Engineering Careers

The Ministry of Labour has published a booklet entitled *Professional Engineers*, which is the latest addition to its " Choice of Careers " series. This booklet explains the various methods of engineering training and comments on the kind of work that engineers do, including research and development, design, production planning, installation and plant operation. In addition, there are chapters devoted to the work of a few representative engineers and to the prospects in the profession for men and women.

The booklet emphasises that professional engineers are valued for their ability to apply their knowledge and to set other people working on the right lines. It points out that as scientific discoveries reveal more about the properties of matter, engineers seek the means of putting that knowledge to practical use. All the work of a senior professional engineer, the booklet observes, is at the level of managerial decision and responsibility. Moreover, it is added, there is a tendency, where administrative work involves technical matters, for the highest appointments to be given more and more often to men with an engineering background.

The booklet is available from H.M. Stationery Office, price 1s. 9d.

Management Development

The Institute of Personnel Management has published a booklet, by Mr. F. I. de la P. Garforth, entitled *Management Development*. It is described as " a systematic approach to the provision of managers and supervisors." The subjects covered include organisation charts, staff reviews and appraisals, forecasts of vacancies, recruiting policy, further education and training for staff and job rotation and exchange. There is also a chapter dealing with the initiation and operation of a systematic management development policy.

The " new approach to management training " is commented upon by Professor T. E. Chester in the June issue of *District Bank Review*. Professor Chester says that everywhere in Europe industry is awakening to the problem of management training and executive development. Europe, he thinks, has lagged behind in this respect in the past. One reason for that, according to Professor Chester, is that the small family business which was typical of European industry before the war could not afford the cost of executive development and, of course, saw no need for it, as it could rely on kinship or the open market to provide for management succession. Another reason suggested by Professor Chester is that the classical basis of western culture does not favour vocational education ; in particular, he comments, the orientation of the universities to legal training has been another serious obstacle. But, Professor Chester continues, all that is now changing. The development of large-scale organisation and the application of scientific management have led to departmentalism and specialisation which create the need for a different kind of management career and at the same time provide the means for integrated executive development. It is not surprising, therefore, the article adds, to find large-scale industrial firms in the vanguard of the movement to improve the quality of management. Professor Chester goes on to express his conviction that " more than anything else a change of outlook is required in British management and in some British educationalists as well." Already, he says, institutions have been founded on the Continent specifically to relate executive training to the international responsibilities which modern industrial leadership has to bear and to the international conditions within which it has to operate. Steps must be taken, he urges, to ensure that the development of British management is also geared to the vastly widened scope and ramifications of modern industrial leadership.

National Society for Clean Air

The National Society for Clean Air (Palace Chambers, Bridge Street, Westminster, S.W.1) has published the *Clean Air Year Book*, 1959. It contains a guide to the Clean Air Act and to the orders and regulations made under it and deals with many aspects of work being done for the prevention of air pollution.

The Society's annual report for 1958 is also included in the year book. This says that although pollution has been reduced, or prevented, a vast amount of work remains to be done and the " advances so far made are more in the nature of the opening of a road than of progress along it." Moreover, the report comments, the advance in public opinion that has been so gratifying is as yet small compared with the further advances that must be made if the clean air programme is to succeed in the time the Beaver committee estimated was reasonable.

Auto Silo at Basle

THE city of Basle, probably more than any other Swiss town, is suffering from an acute shortage of parking space. Traffic in the last five years has almost doubled, and although parking meters discourage parking in main roads for lengthy periods, the real problem is the provision of parking facilities in the central area. While to provide such parking facilities at the fringe of the city has some merit, public transport from the fringe area to the centre has not been attractive enough to make this acceptable.

The idea of providing parking garages in central areas is by no means novel, and in America a great number of such garages have been built either by private enterprise (for instance the roof garages of big department stores) or sponsored by municipal authorities. As the land in central city districts is very expensive and the sites are frequently of awkward shape, much ingenuity has been shown to utilise to the best advantage the available area both above and below ground. This leads logically to multi-storey garages which might differ considerably in their overall layout by the manner in which the vehicles are being moved to and from their storing places.

Of the two best-known categories of multi-storey garages, the ramp garage and the elevator garage, the former is not entirely suitable as parking garage: the straight or spiral ramps, which give access to the individual storeys, take up considerable space, and during rush hours the handling of the vehicles suffers delay, mostly at the entrances or exists.

The other category, the elevator garage, requires about 40 per cent less space than the ramp garage; in garages of this system the cars are conveyed to and from their storage spaces by elevators, in modern installations generally by travelling lift towers, and the entire handling of the vehicles is done by mechanical means. As the driver leaves his car at the entrance of the garage, no time is lost when depositing the vehicle, and short delays will only occur if he collects it during the rush hours.

The Auto Silo at Basle which was opened last year is an eight-storey garage with three travelling lift towers; it has storage space for about 380 cars, i.e. a capacity which exceeds that of the four largest parking lots in the central Basle area. The mechanical handling machinery is automatically controlled so that the entire cycle of operation, from the arrival of a vehicle until its collection, can be directed by one attendant seated at a control desk at the entrance of the garage. This system, although rather expensive in first cost, is cheap in wages and greatly reduces the time required for the transfer of the cars to and from their parking boxes.

Fig. 1—Aerial view of silo-garage and hotel

The garage forms part of a building compound, comprising in addition a hotel, a restaurant, a service- and filling-station, and a block of flats and offices. The aerial photograph (Fig. 1), and the longitudinal section (Fig. 2) show the position of the garage at right angles to the front of the hotel which faces a busy main street (Steinentorstrasse) near the Basle railway station. The block of flats at the rear of the garage building faces a side street (Wallstrasse), running parallel to the main street but at a level 50ft higher. Access to the nine drive-in and the nine exit boxes at the ground floor of the garage is provided by two passages through the hotel building. Another passage through the block of flats at the rear leads from the side road to a courtyard and gives access to two combined entrance-and-exit boxes, both of which are level with the eighth floor of the garage.

Erection of the buildings took about three-and-a-half years as some difficult civil engineering problems had to be overcome. The work involved constructing a retaining wall 73ft high and up to 23ft thick; taking full precautions against the high ground-water level and sound-proofing the garage relative to the hotel and the office buildings. In view of the automatic control of the mechanical handling machinery close tolerance was specified for the ferro-concrete work on the elevator towers, deviations of not more than $\pm\frac{1}{16}$in being allowed for a building more than 180ft long, 65ft wide, and 70ft high.

The mechanical handling system of the Auto Silo was designed by Sicomatic A.G., Zürich (owners of the international patent rights) in collaboration with Mohr and Federhaff A.G. of Mannheim, the latter firm being responsible for the making and the erection of the complete handling machinery. The Auto Silo system is based on American experience with similar garages, but much modified in detail in order to make it suitable for Continental conditions.

The basic form of the American parking garage could be maintained, namely that of a rectangular multi-storey building, containing on each floor two rows of storage cells, both facing towards a 22ft-wide central aisle which extends over the whole length of the building and serves as well for three travelling lift-towers. Each tower contains an open-ended lift cage which is equipped with means for picking up the car from the drive-in box on the ground floor and depositing it in any selected cell on either side of the building, or vice versa, to collect it from the cell and deliver it to the exit box. The system employed at Basle differs from American installations mainly in the design of the lift-cage conveyor which has to deal with a greater variety of cars, differing among themselves considerably in weight and dimensions. On each of the seven upper floors there are twenty-four open parking boxes, twelve on each

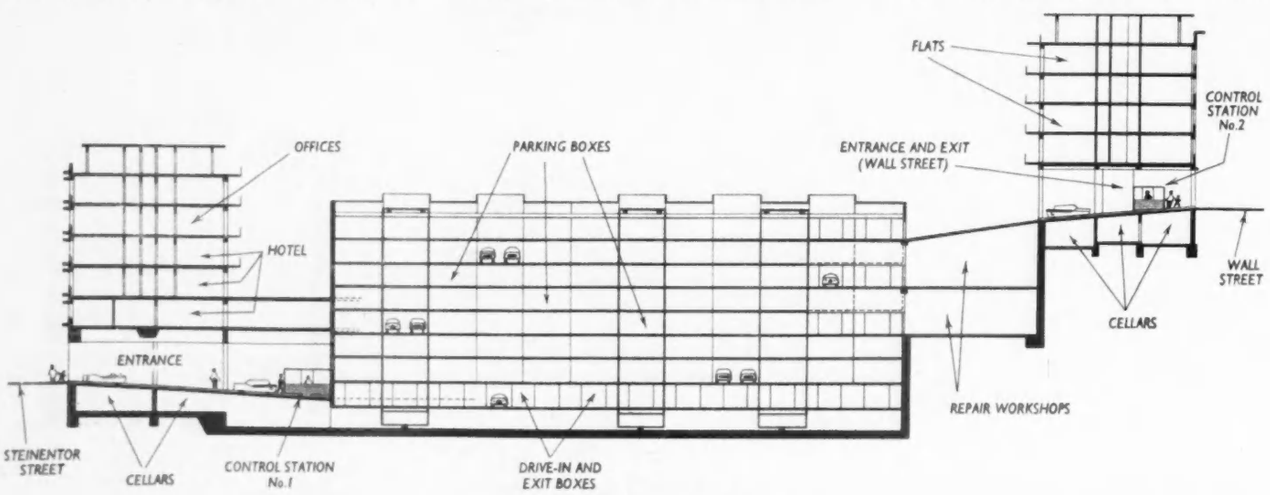


Fig. 2—Sectional elevation of auto silo

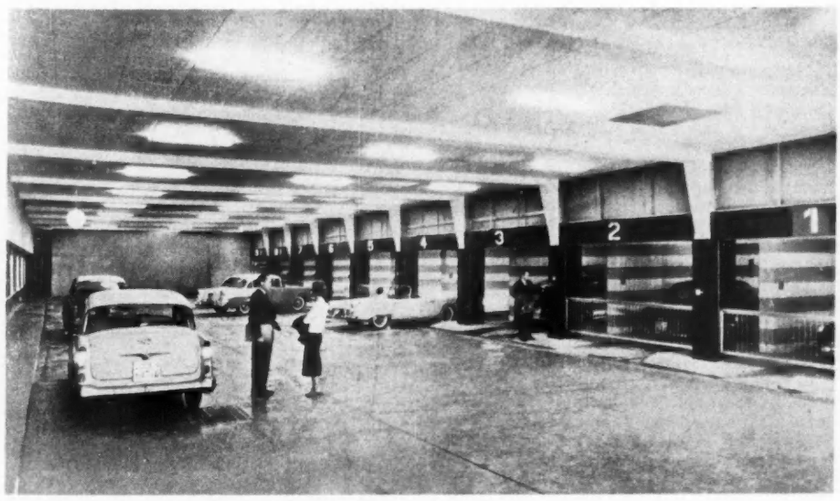


Fig. 3—Drive-in hall with nine drive-in boxes on the Steinentorstrasse side

side of the gangway. The boxes are just large enough to house side by side two large private cars with only a few inches of space left between the vehicles, the walls and the ceiling. The boxes on the first floor are slightly higher than those of the other floors so that they can be used for cars of more than average height or those carrying luggage on a roof rack. The boxes on the ground floor are similarly arranged (Fig. 3), and serve as drive-in and exit boxes respectively ; they are shut off from the gangway by sliding doors which open automatically only when the lift cage of one of the elevators is in front of the door. Although the width of all boxes is uniform, each parking box houses two cars, while the drive-in and exit boxes can only accommodate one vehicle as sufficient room has to be left for the driver to leave or enter the car. Shallow grooves in the floor of the drive-in and exit boxes guide the wheels to facilitate the transfer of the vehicle to the lift cage.

When planning the layout of the mechanical handling installation it was assumed that the regular clientele of the garage would probably comprise about 50 per cent of long-term parkers and 40 per cent intermediate parkers, further that the morning and evening peaks would take up about 50 per cent of the storage capacity, and the midday peak between 30 and 35 per cent. Starting from this assumption (which has since proved to be very accurate) it was decided to install three travelling elevators, each capable of dealing with approximately sixty cars per hour. In the morning. and in the evening all three elevators are in operation for about one or one-and-a-half hours ; the peak at midday can generally be handled by two elevators, and the remaining hours by one. As the elevators are automatically controlled, no additional personnel has to be employed during the rush hours ; the system, therefore, is very flexible, and capable of dealing with unexpected peaks which might occasionally occur.

Fig. 5 shows the aisle of the garage under construction, with one of the three elevators in position. A platform on wheels carries the drive gear for the horizontal travel, the hoist for the lift-cage and the electric control units. This platform runs on two rails mounted at the top of the aisle. The lift-tower itself is flexibly joined to the platform and is additionally supported by a separately driven, single-axle bogie attached to its base, and running on a rail in the pit of the aisle. Because of the flexible connection between the lift-tower on the one hand and the platform and the supporting trunk on the other hand it was possible to make the steel structure comparatively light as it has only to take the inertia forces at the horizontal travel. The weight of the tower, that of the lift-cage, the load and the balance-weight, are all carried by the top platform. The drive of the platform at the top and that of the supporting truck at the bottom are neither mechanically nor electrically connected. The horizontal speed of the elevator structure is 2ft per second, the vertical speed of the lift-cage about 3ft per second ; the slow approach speed when entering a box is about one-tenth of the normal operational speed. The operational ranges of the elevators partly overlap, but the risk of a collision is excluded by appropriate safety devices.

The lift-cage contains the means of conveying the car from the cage to the box and vice versa. While the elevator and the lift-cage are in motion, the wheels of the car, the handbrake of which is applied, rest in shallow grooves on the floor of the cage. Underneath the car is a low-platform trolley which runs on rails mounted in a recess of the cage floor. The trolley is equipped with a lifting device which remains locked while the elevator is moving. When the lift-cage has come to rest at the entrance of an unoccupied box, two pneumatically-controlled arms lift the rear wheels of the car a few inches off the floor ; at the same time an electrically-driven winding mechanism moves the platform trolley partially out of the open-ended lift-cage so that it protrudes into the selected box which can be on either side of the garage building (Fig. 4). The car is pushed into the box, the front wheels being guided by grooves in the floor of the box corresponding to those of the lift-cage. The lifting device is lowered, depositing the car in its correct position, and the platform is withdrawn into the lift-cage and locked relative to the latter ; the elevator then is free to move again. During the transfer operation there is no electrical and, apart from the steel ropes of the winding mechanism, no mechanical connection between the platform truck and the lift-cage. The compressed air required for operating the lifting device is taken from an air-receiver mounted on the truck ; this receiver is automatically re-charged by a small compressor unit mounted in the lift-cage, once the platform truck has been retracted into the latter.

Each drive-in box contains a directional device for the purpose of guiding the car relative to the centre line of the lift-cage ; further, when the car enters the box the ground clearance is checked automatically to prevent any damage arising from the under-sliding platform truck. The exit boxes, arranged opposite the entrance boxes on the other side of the aisle, are of similar construction, but have neither directional devices nor clearance sensors.

The actual parking operation takes place as follows. The driver of a car entering the garage stops at the control desk where the height of the vehicle is checked by a photo-electric cell ; cars exceeding a certain height can either be accommodated in the higher boxes on the first floor or, in extreme cases, have to be rejected. The attendant at the control desk presses a key which actuates a series of automatic selectors in the control room in the basement of the building. These selectors, which are similar to those used in automatic telephone exchanges, scan the contact terminals of the parking boxes until they have found a vacant one and signal its number back to the control desk. The attendant then types this number, the registration number of the vehicle, and the date and time of arrival on a ticket which is handed over to the customer ; these data are simultaneously transmitted by a teleprinter to the office, thus providing a record in case the customer should lose the ticket. The driver is directed to drive his vehicle to a vacant drive-in box, preferably one within easy reach of an elevator within range of the selected parking box, and the elevator receives a signal to proceed to the appropriate drive-in box. While the car enters this box the elevator and the lift-cage, both moving simultaneously, take up their position, at the exit side of the box ; the sliding doors separating the box from the gangway, however, remain closed. The driver having applied the handbrake alights and leaves the box ; he then presses a button outside the box whereupon a barrier shuts the entrance. The doors at the exit side of the box open, the platform trolley is shifted underneath the car, and the latter is pulled into the lift-cage. The platform-truck being secured in the lift-cage, the sliding doors of the drive-in box close, and the car is conveyed automatically to the pre-selected parking box and deposited there in the manner previously described. Lamps at the control desk, one for each individual parking box, give intermittent signals while the process of conveying a car to and from a parking box is taking place.

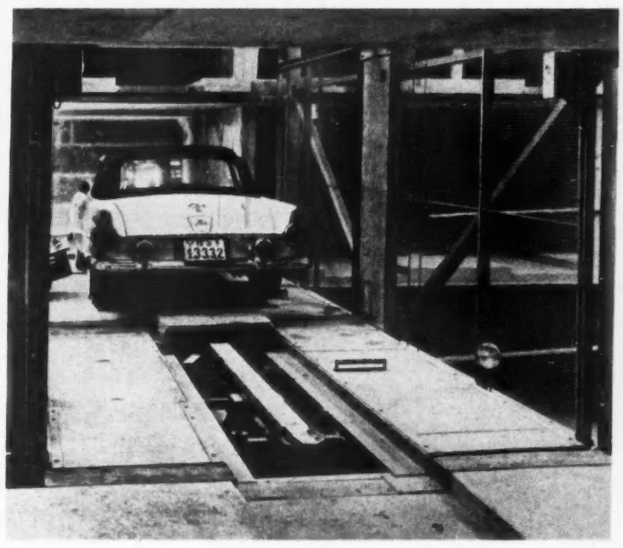


Fig. 4—Car entering box from lift. The braked rear wheels are raised by the conveyor

When collecting his car the customer goes to the control desk and hands in his ticket, the attendant reads the parking time which is automatically registered for each parking box, gives a receipt for the parking fee paid and presses the " exit " button of the occupied parking box. While the car is being collected by the elevator, a light signal indicates the number of the exit box to which it is being delivered. The oustomer goes to drive-out side of the garage, opposite to the reception hall, where a light signal at the selected exit box warns him not to enter before the car has been safely delivered, the platform

truck retracted and the entrance doors closed. Depositing or collecting a car takes something between thirty and ninety seconds according to the distance between the parking box and the drive-in or exit box respectively.

The automatic control of the handling mechanism can be so adjusted that during the rush hours all elevators can be engaged on "one-way" traffic only, i.e. for depositing the vehicles in the morning and for collecting them in the evening. The electrical control system of the mechanical handling machinery has been designed and installed by Siemens a d Halske A.G., Munich.

Fig. 5—Elevator well with parking boxes on both sides (during construction). In the centre, elevators with conveying system

Not less than 375 miles of wiring with 150,000 soldered connections and hundreds of relays are required, not only for effecting the succession of steps comprising each individual operation, but also for the various blocking and safety devices and for the extensive indicator system which informs the attendant at the control desk at a glance of the occupation of the parking boxes and of the relative position of the three elevators. In case of the failure of some essential safety device, for instance of the sensors checking the maximum permissible dimensions of a vehicle, light signals are automatically given to the control desk from where the affected part of the garage can be immediately blocked. Should one of the three elevators be out of order, each one of the others can take over and serve all boxes without the risk of a collision. In case of a defect of the automatic lift-control system, each elevator can be directed either by remote control from the desk or by a manual control inside the lift-cage. There is also a danger-indicating circuit by which the entire plant can be brought to an immediate standstill. Provision has been made for taking out of action a section comprising half the total length of the building for the purpose of cleaning or maintenance ; the control desk then cannot direct any vehicles to or from the blocked-off part of the garage until it has received the "all clear" signal.

Reference has already been made to the means provided for giving the automatic system a certain degree of flexibility, such as dealing with uni-directional traffic during the rush hours. The regular flow of movements can also be interrupted in such cases as giving preference to a doctor's car which has to be taken out without delay, or when conveying a car from a parking box to the service station on the eighth floor of the building which is linked to the control desk by a pneumatic communications system.

Esso A.G., Hamburg

In its annual meeting held on June 3, Esso A.G., Hamburg, reported a doubling of its investments (nearly DM.200 million) last year compared with 1957 (DM.100 million). Work included the new refinery at Cologne (DM.135 million during 1958), expansion of distribution facilities (DM.50,000,000), as well as improvements at the Hamburg refinery (DM.15,000,000). The company is continuing its expansion programme this year, being of the opinion that the consumption of petroleum products in Germany will continue to increase.

The turnover of Esso A.G. increased by 10 per cent to approximately DM.1900 million (DM.1700 million), which, after deduction of customs and excise charges, left a gross profit of DM.1400 million (DM.1300 million). Because of increased competition, in particular in the field of fuel oil, the net result is a loss of DM.19,300,000, compared with a profit of DM.8,400,000 in 1957. After deducting the amount of profit carried forward from that year, a loss amounting to DM.12,400,000 is being carried forward into the new operational year.

In 1958, Esso A.G. imported nearly 5,000,000 tons of mineral oil, including nearly 37 per cent finished products. This last figure will probably fall to 10 per cent this year owing to the coming on stream of the Cologne refinery at the end of last year. An increase in throughput of nearly 20 per cent is reported from the Hamburg refinery, which has been running at its full capacity of 2,600,000 tons per annum.

Esso Tankschiff Ruderei G.m.b.H., the Esso subsidiary for seagoing and inland shipping, at present operates a fleet of twenty-seven tankers totalling 533,000 tons deadweight, including seven tankers of its own, which, together, add up to over 205,000 tons deadweight. Two tankers of 36,000 tons deadweight, three of 47,000 tons deadweight, and two of 73,000 tons deadweight are either building or on order in German shipyards.

Impedance Deviation Bridge

For the rapid production line control of electrical components, Aktieselskabet Brüel and Kjær, Nærum, Denmark, has produced a series of deviation bridges showing the variation of impedance from a given standard directly in per cent, and the difference in phase angle in hundredths of a radian. The four versions differ only in the measuring frequencies which are 100 c/s, 1 kc/s, 10 kc/s, and 100 kc/s. Each instrument consists of a basic bridge circuit arranged for connecting the external standard and the unknown component, a built-in generator for the bridge supply, a two-stage phase-linear amplifier, and a meter circuit with a large illuminated moving coil meter.

The meter is supplied with interchangeable scales permitting the use of a single scale for each sensitivity range. Additionally, blank scales are supplied on which special tolerance limits can be drawn. The meter has its zero point in the centre and the accuracy for scale readings close to zero is stated to be 0·03 per cent. For components such as wire-wound resistors and electrolytic capacitators, the model with a frequency of 100 c/s is suitable, while 100 kc/s are recommended by the maker for small capacitators and inductances ; 1 kc/s is stated to be applicable to general use in the laboratory and for production control. With a complete series of instruments, it is stated to be possible to test components ranging from 20μH to 2000H, 20pF to 5000μF, and 1Ω to 30MΩ. A jig is available to facilitate testing on the production line. This allows optimum pressure on the leads of the component to be applied by knee pressure and is stated to permit the carrying out of tests of up to 3600 components per hour. The instrument is shown in the accompanying illustration.

Deviations of the impedance of a component from a standard can be read directly in per cent, and the variation of phase angle in 1/100 radian by the deviation bridge illustrated here. Using the knee-operated clamping jig shown, one can, it is stated, test up to 3600 components per hour

CERN Council Meeting

First-quarter progress reports for 1959, budget estimates for 1960, the annual report for 1958, new appointments, and the admission of Austria as thirteenth member country to CERN, were the main topics discussed at the thirteenth session of the Council of CERN, European Organisation for Nuclear Research, in Geneva-Meyrin, on Tuesday, May 26. In his report, the director-general, Professor C. J. Bakker, stated that CERN's 25 GeV (25,000 million electron-volt) proton synchrotron would begin trial operations at the end of this year or early 1960, in accordance with schedule. The second particle accelerator, the 600 million electron-volt synchro-cyclotron, has been in operation at full capacity since the beginning of 1958, and has already furnished major contributions to research. In particular, it was used to demonstrate the theoretically long prophesied mode of the decay of the Pi-meson directly into an electron.

Both particle accelerators will benefit from an increasingly extensive programme of instrumentation, now being prepared. This will include the construction of big bubble chambers, beam transport and shielding devices, nuclear data processing, high-speed electronic counters, photographic emulsion techniques and cloud chambers. The general purpose of this secondary instrumentation will be to analyse more and more profoundly the properties of the beams of the elementary particles produced by the two machines. A ceiling of 120 million Swiss francs was accepted by the council for contribution for 1959 and 1960. This sum will cover estimated expenditure for the completion and operation of the accelerators, research on new accelerating techniques, and the experimental programme for both accelerators, as well as administration general services and staff expenses.

V.D.I. Travelling Exhibition

A travelling exhibition for designers, dealing with the theme "Design for the Plastic Forming of Machine Parts," will be shown this month at the Rheinisch-Westfälische Technische Hochschule, Aachen. Arranged by the V.D.I., at the suggestion and with the co-operation of Professor Kienzle, Hanover, the show contains a large number of illustrations from industry as well as working models. The second section brings examples from the various fields of engineering, such as internal combustion engines, naval architecture, railway engineering, agricultural technology and so on. In connection with the show, the V.D.I. is arranging a series of lectures.

American Nuclear Engineering Conference

BY OUR AMERICAN EDITOR

No. V—(*Concluded from page 905, June 5*)

The fifth Nuclear Engineering and Science Conference was held at the Public Auditorium in Cleveland, Ohio, from April 5 to 10, in conjunction with the 1959 "Atomfair" exhibition. The conference was organised under the sponsorship of the Engineers Joint Council in co-operation with twenty-seven American and Canadian engineering institutions. The exhibition was sponsored by the Atomic Industrial Forum and presented a comprehensive picture of the current state of development in the application of atomic energy in American industry.

Martin Company

LAST week's article concluded by outlining the work done on thermoelectric conversion of isotope power by the nuclear division of the Martin Company, Baltimore, Maryland,

This firm is now developing a 100W ground-based thermoelectric generator to be fuelled by a compound of Strontium 90 and designed to operate for almost a decade without servicing or refuelling. Like SNAP–III, this generator will have no moving parts. The 28-year half-life of Strontium 90 will enable it to provide continuous power over many years ; if it were linked to an energy-storage system it could provide intermittent bursts of much higher energy than 100W (e.g. for a high-powered wireless transmitter which might be required to broadcast for only a few minutes each hour). The present design calls for a cylindrical device about 22in high and with an outside diameter of 26in, including shielding and "radiator" fins to dissipate heat from the cold junctions. It will be fuelled with several hundred thousand curies of Strontium 90. A number of safety features are incorporated in the generator design. First of all, since Strontium 90 is particularly a biological danger in soluble form, the fuel elements will be fabricated of an extremely stable, insoluble compound. Secondly, the compound will be sealed in corrosion-resistant capsules inside a massive heat sink, which by itself would take centuries to erode even if immersed in sea water. Finally, the ground-based unit will incorporate about 2½in of lead shielding.

Although the supply of refined isotopes is limited at present, the "raw material" for isotopic power is increasing steadily. Unfortunately, mixed fission products are not suitable for use just as they come from the reactor. The presence of short-lived isotopes cuts power density sharply, and the chemical stability of the mixture at high temperature is difficult to predict. The erratic variation in decay energy also raises control problems. At present the separation and refinement of usable isotopes is being carried out on a pilot plant level, in keeping with existing demand ; but growing requirements based on the new technology of isotopic power could probably be met by the addition of new and larger facilities.

American Machine and Foundry Company

The exhibit of the American Machine and Foundry Company, Greenwich, Connecticut, stressed the light-water moderated tank research reactor, as recently supplied to the University of Delft (Fig. 25). Combining inherent safety with a maximum number of experimental facilities, the AMF tank reactor is designed to provide the high flux levels frequently called for in certain fields of basic and applied research. A light-water-moderated, solid-fuel reactor, employing water as the coolant and shielding, the reactor incorporates a number of significant operating advantages. Visibility of the core is maintained through the use of transparent shields. These lightweight, removable shields simplify rearrangement of core loading, provide quick access to the irradiation space in the water tank and yet offer all the advantages of an enclosed metal vessel. Highly compact for a reactor of its power and numerous experimental facilities, the tank reactor allows a minimum building size to be employed. The controls are of the overhead design and are thus not only protected from the undesirable effects of high humidity, but are easily accessible for inspection and maintenance.

The numerous experimental facilities offered in the AMF tank reactor, together with the high fluxes available, make possible a wide range of studies, in practically every field of nuclear research. The reactor design includes facilities for bulk and gamma radiation, as well as numerous independent beam holes for physics research and hot loop experiments. It can easily

Fig. 25—Light-water-moderated tank research reactor installed at the University of Delft

be converted into an engineering test facility and may include further modifications such as a canal or hydraulically operated pass-through tube with little or no effect on the facilities inherent in the basic design. A typical installation would include : seven 6in diameter beam tubes ; one 12in square beam tube ; one pneumatic rabbit loop ; one hydraulic rabbit ; one thermal column ; one engineering test facility ; two 6in diameter through-tubes ; a substantial bulk irradiation area ; and a dry gamma radiation facility.

Designed for maximum experimental capacity, the AMF tank reactor may be operated at power levels ranging from 100kW low-level operation to 5000kW for the higher fast and thermal neutron fluxes often required. Systems with higher power levels are available for those instances where such levels are required. The employment of the core grid design, which includes movable control rod guides and positive hold-downs, provides unusual flexibility of flux patterns and power levels at the various facilities. By rearranging fuel elements, control rods and canned graphite reflectors, both the flux level and the ratio of fast to thermal neutrons can easily be distributed to meet specific research requirements.

The general specification of the reactor is as follows :—

Fuel	20 per cent or 90 per cent enriched U-235 in uranium and aluminium alloy, MTR type, aluminium clad fuel assemblies
Power	5, 10 or 15tMW
Lattice	54 holes on 6in by 9in pattern
Flux density	3×10^{13}n/cm^2-sec (average thermal based on 20 per cent enriched fuel at 5tMW)
Moderator	H_2O
Reflector	H_2O and graphite
Shielding	H_2O, lead, regular concrete and high density concrete
Cooling	Primary loop—heat exchanger Secondary loop—cooling tower
Control	5 boron-carbide shim-safety rods 1 stainless steel regulating rod

United Shoe Machinery Corporation

Several models of seal welding and cutting equipment were demonstrated at the stand of the United Shoe Machinery Corporation, Beverly, Massachusetts. The design and development of automatic seal welding and cutting equipment for nuclear reactors is an important activity of this firm. With the requirement for replacing spent fuel elements and the need for periodic repair and replacement of control drive mechanisms, reliable equipment to perform the seal welding and cutting function is of vital importance. The company designed and manufactured this cutting and welding equipment for the U.S. Navy Submarine "Triton" under contract with the Knolls Atomic Power Laboratories and the Naval Reactors Branch of the Atomic Energy Commission. The welding technique and equipment developed by United Shoe Machinery Corporation permits making final closures of Omega seal welds on pressure vessels to render them leakproof and pressure-tight. The welds must be of very high quality, since inspection due to the nature and location of the weld is virtually impossible.

The design of the "Triton" reactor required 11in diameter seal welds on the control rod drive mechanisms to be made at various angles in a limited space envelope with any or all of the other mechanisms in place. In addition to these field installation welds, the equipment was required to support the control rod drive mechanism at the time of welding or cutting. The firm developed a consumable insert welding technique for making final closure welds or seal welds that provide a hermetically sealed joint between control drive mechanisms and reactor pressure vessels. The welds are performed with the inert-gas, tungsten-arc process using filler metal in the form of a prefabricated, preplaced consumable insert. The insert is designed so that it may be accurately positioned in the groove, to yield a weld of full penetration having smooth face and root contours. The three

definite and distinct advantages of this technique are that the use of preplaced filler metal precludes the use of other space-consuming wire feed mechanisms ; it has greater latitude of misalignment of the component seal lips while performing the weld, and it permits a weld to be cut open and rewelded with neither of the lip components being expendable. The groove joint is of rectangular cross-section so that after a weld has been cut open, only a minor dressing is necessary for subsequent welding. This procedure allows the same two lip components to be cut open and rewelded at least five times.

The equipment consists of a welding machine, a sequencing control panel and a commercial welding unit of the d.c. rectifier type. The welding machine consists essentially of a welding torch moving in a fixed circular path around the control drive mechanism and over the seal weld area. The torch (Fig. 26) is correctly set

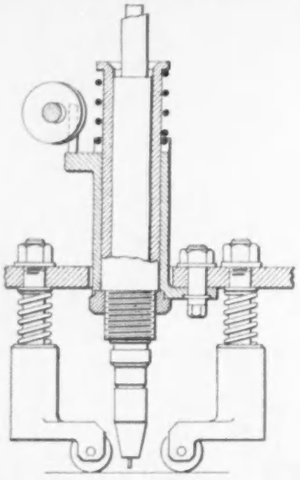


Fig. 26—Torch of " United " seal welding machine

at the proper angle and distance from the joint to be welded and mounted in a fixed position on a cage that rotates on ball bearings within a stationary frame that is bolted to the reactor head standpipe. The rotating inner cage is driven in a clockwise direction at a predetermined speed by a small electric motor mounted on the outer frame. Spring-loaded retaining rolls are built into the rotating inner cage to hold the stainless steel consumable inserts firmly in position during the welding sequence. Argon gas is used in both the torch and the envelope enclosing the machine. A high-frequency, high-potential electrical field is established across the gap between the electrode and the work. The argon gas at the torch is ionised by the high frequency and potential and permits the welding current to flow. The stainless steel consumable insert wire situated in the arc is fused to the seal lips to complete the Omega seal. The complete welding operation is automatically controlled through relays and switches in the welding control unit mounted on the machine.

The primary purpose of the seal cutting machine is to cut the seal on the upper mechanism assembly of the control drive mechanism where it is seal welded to the reactor head standpipe. The rotating inner cage carries a cutter which progressively cuts through the $\frac{1}{16}$in seal weld. A $\frac{1}{4}$ h.p. motor mounted on the frame drives the unit through a reduction gear assembly at a constant speed of 10 r.p.m. in a circular path around the control drive mechanism and over the area to be cut. A manual feed handle with micrometer indication dial allows rigid control of the depth of tool cut. The control drive mechanism is held firmly in place during the cutting operation by applying pressure to the hold-down screws positioned in the cage cover.

The company also exhibited its new "Harmonic Drive " method of transmitting power through the use of controlled deflection. As far as is known, this may be the first development utilising a continuous deflection wave for the positive transmission of power. The wave reaches easily through steel walls, vessels or pipes to produce powerful rotary, linear or angular forces. Tnroughout its design and development stage, " Harmonic Drive " has continued to defy analysis and classification within the usual fundamental elements of the lever, the wheel and the inclined plane. The principle can perhaps be most readily understood by a description of its application to the rotary version, wherein as little as three basic parts are involved (Fig. 27). There is a splined ring with internal teeth, mating with a " flex spline " having external teeth. These teeth are all of one circular pitch, and the areas of engagement are in full mesh. The inside of the " flex spline " is acting as the outer race of a ball bearing. The inner race is elliptical, and causes the teeth of the spline to be in full engagement along the major axis of the ellipse. Along the minor axis the teeth are fully disengaged. The inner race is called a wave generator, since rotation of the ellipse generates a travelling harmonic wave. As the wave generator is rotated it causes progressive tooth engagement. The teeth are always in mesh along the major axis and out of mesh along the minor axis. There are fewer teeth on the " flex spline " than on the splined ring ; therefore, each rotation of the wave generator moves the " flex spline " teeth a distance equal to the tooth differential between the splines. Where the teeth are meshed, they are stationary, acting as splines in total area contact. The movement of the " flex spline " or driven member is confined to that area where the teeth are disengaged. It is obvious that this arrangement incorporates inherently great strength with negligible wear and noise. In many types of application, little or no lubrication of the teeth is needed.

The application of " Harmonic Drive " appears to offer : (1) Large mechanical advantage—actual values up to several million to one may be positively and continuously produced with simplicity and with reduced package design. (2) High efficiency—test units have been made where the only losses are in the anti-friction bearings and the hysteresis effect in the flex spline. Both of these are quite small. Even for large mechanical advantages the efficiency remains exceptionally high. Normally, there is only one internal part which, at its points of contact with the vessel wall, is essentially stationary. As a result, friction losses are very low and lubrication is normally not required. (3) Precise motion control—motion is produced by progressively advancing a controlled deflection wave along the periphery of a ring. As this wave is sinusoidal and without discrete steps, the output bears a precise functional relationship with the input, without backlash. (4) Operation through a hermetic seal—powerful motion can be transmitted and controlled directly through a vessel wall. The wall is left intact and no packing, stuffing boxes or seals are used. (5) Rigidity—the connecting links between the stationary member and the output are multiple in number, short in length, and of such shape as to produce a maximum resistive moment. For example, in the rotary version the output is coupled with the stationary member by a short tube. One end of this tube is splined, keyed, welded or integral with the output shaft and the other end is splined at several places directly with the stationary member. Torsionally, this is the most rigid coupling known (6) Quiet operation—the only sound is produced by the ball or roller bearing used in the wave generator. The other parts move into mating relationship at the peak of a harmonic or sine wave where their contacting velocities and sound radiation are negligible. (7) Simplicity—fundamentally there are only three parts—a housing, an input wave generator and an output. Complete working units have been made with a total of only these three parts, which tend to be self-supporting and self-centring. Additional structure and complication are added only for foreign matter exclusion, absorption of exterior lateral forces, assembly convenience or to facilitate manufacture.

Among the applications of " Harmonic Drive" which are currently under development by the firm, of particular interest to the nuclear field is a Rod Drive Mechanism, in which an external rotary motion produces internal linear motion through a hermetically sealed tubular wall for the control of a nuclear reactor. All motion generating parts are outside the wall. The internal screw is engaged with threads on the inside of the tube at several points, or areas. These contact areas rotate around the screw by means of propagation in the tube wall of a harmonic deflection wave. Large linear forces are generated with precise control. Since the inside screw is always in positive mechanical interlock with the outside rotary motion, positive position indication can be accurately obtained from the outside.

High Voltage Engineering Corporation

The initial display of the Model " PN-400 " 0·4MeV Van de Graaff Neutron Source (Fig. 28) took place at the stand of the High Voltage Engineering Corporation, of Burlington, Massachusetts. This positive-ion accelerator provides a versatile, compact and inexpensive neutron source capable of both pulsed and continuous operation. Sufficient neutron intensity from

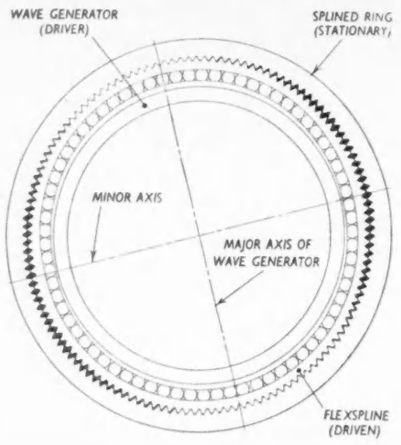


Fig. 27—Rotary version of " Harmonic Drive " method of power transmission

both the D-D and D-T reactions may be obtained for many applications hitherto requiring considerably more expensive accelerators or limited by less versatile sources. With the appropriate targets and a moderator, thermal neutrons or mono-energetic neutrons with energies of 2MeV or 14MeV may be generated in a variety of pulse lengths and repetition rates or with continuous output. Typical applications of the machine are studies of neutron scattering, neutron-induced nuclear reactions, transient and steady-state effects in sub-critical reactor assemblies, radiation damage, shielding parameters, activation analysis, and the biological effects of neutrons. Because of its low cost and simple, safe operation, the accelerator is ideally suited to the teaching of nuclear physics and reactor technology as well as use in other fields in which the use of nuclear radiations is of growing importance.

The " PN-400 " is the lowest-priced neutron source offering both pulsed and continuous operation, with positive-ion energies considerably above 100kV. Pressure insulation results in a small size. The overall accelerator length is 63in and the extension tube is 48in long. Except for the separate control cabinet to be situated outside the experimental area, the machine is a single unit. The placing of the target at ground permits the use of a long acceleration-tube extension for pulsing sub-critical assemblies and also permits water cooling of the target. The water-cooled target permits the use of full beam power for continuous neutron yield per microampere of deuterons at 400kV is nearly ten times that at 100kV, thus greatly increasing the target life for a given neutron output.

The performance ratings of the unit are:

Voltage	0·40MeV
Continuous beam current	Controllable, 10–150 microampere
Monatomic ion yield	At least 50 per cent of beam current
Pulsed current amplitude	10 to 100 microampere
Beam diameter for 90 per cent of current	1cm maximum
Pulse lengths	Available from 10 to 200 microseconds
Pulse rise and decay times	3 micro-seconds, maximum
Repetition rates	From 1 to 1000 p.p.s. or 100 to 10,000 p.p.s.
Duty cycle	10 per cent maximum

Six preset combinations of pulse length and repetition rate in the ranges indicated may be specified by the customer and will be provided with the accelerator. They are selected by means of an external switch. A variety of additional pulsing schemes can be supplied upon request. Up to twenty-four combinations of twelve pulse widths and twelve repetition rates can be provided with simple circuit changes. Single-pulse operation is also possible with simple circuit additions.

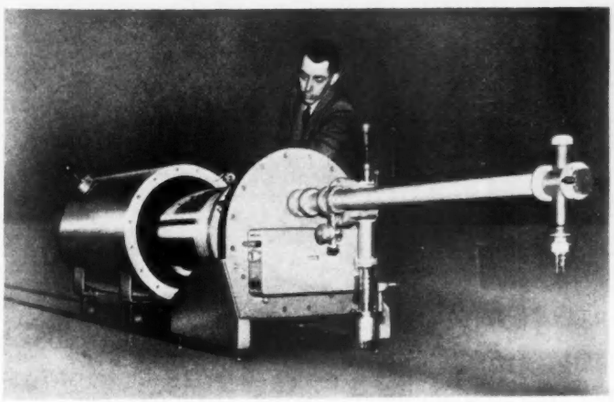


Fig. 28—Model of "PN-400," 0·4 MeV Van de Graaff neutron source of the High Voltage Engineering Corporation

The yield and lifetime of thin neutron-producing targets vary widely with beam and target conditions. Recent results in the development of these targets indicate that there are now available targets that will produce a total yield of more than 10^8 neutrons per second per microampere of deuterons at 400kV. Since, at this energy, the neutron yield per microampere does not differ significantly between monatomic and diatomic deuterium on a thin tritium target, the full beam current of 150 microamperes is effective in producing neutrons. Thus, in continuous operation at full beam current, using a water cooled target, a total yield well in excess of 10^{10} neutrons per second should be obtainable with a new target. The corresponding moderated thermal neutron flux is less than the total yield by a factor of about 100 and under similar conditions the neutron yields from thin deuterium targets are less than those from tritium by a factor of about 100.

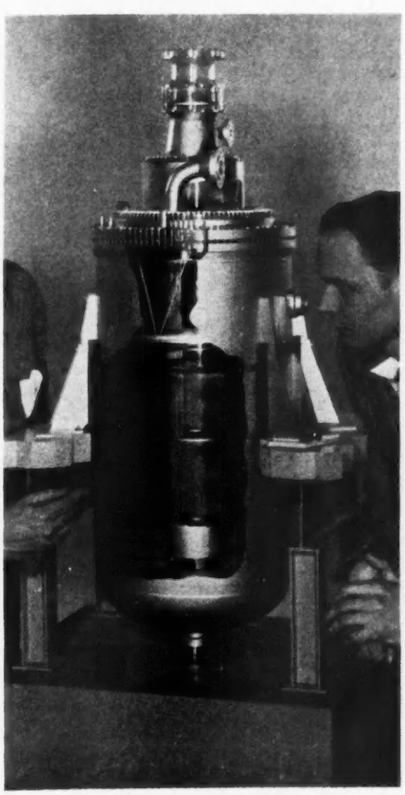


Fig. 29—Model of Griscom-Russell steam generators being built for the 100MW Enrico Fermi atomic power station

Griscom-Russell Company

The Griscom-Russell Company, of Massillon, Ohio, exhibited a model (Fig. 29) of the steam generators now being built for the 100MW Enrico Fermi Atomic Power Station. Superheated steam, at 780 deg. Fah. and 900 lb per square inch pressure, will be supplied by three of these steam generators. The tubes shown in the one-eighth scale model are bent in a serpentine pattern, trombone-nested in banks of eight, and then formed on an involute plane. Each of the three units now being built will measure 26ft 6in high and 106in in diameter. The gas blanketing in the liquid-sodium-heated steam generator, together with additional shell height not required for steam generation, has been provided so that the generator shell also acts as a surge and expansion tank for the secondary sodium system. The pressure loss of the sodium through the shell has been kept very small to maintain a good suction head on the secondary sodium pump connected and adjacent to the steam generator.

Corning Glass Works

A radiation shielding window 8ft 6in in depth, claimed to be the thickest ever built, was exhibited at the stand of the Corning Glass Works, of Corning, New York. The window, which is shown in Fig. 30, weighs 18,000 lb. It contains seven separate glass panes, each 9in thick, and twelve clear plastic sheets. The firm assembled the window for the U.S. Atomic Energy Commission and it will be installed in a new flight engine test facility at the National Reactor Testing Station near Idaho Falls, Idaho. The window is designed to protect persons observing activity in a radioactive shop with inside dimensions of 320ft by 234ft. The window has overall dimensions of 31in by 64in on the "hot" side and 22in by 42in on the viewing side. It is one of a line of radiation shielding units developed and manufactured by Corning. The company supplies the windows in a steel frame and charged with oil, ready for insertion in the cell wall.

S. Blickman, Incorporated

A new glove box offering a high degree of visibility, safety and versatility was exhibited by S. Blickman, Incorporated, Weehawken, New Jersey. Specially designed by the New Brunswick A.E.C. laboratory for use in its plutonium work, the glove box (Fig. 31) features a completely sloping front from bottom to top to prevent the worker from striking his head on the box front when he attempts to view the interior. Another innovation in this box is a front made completely of glass to provide a full view of the interior. Being constructed from stainless steel and laminated safety glass, the unit offers security from fire.

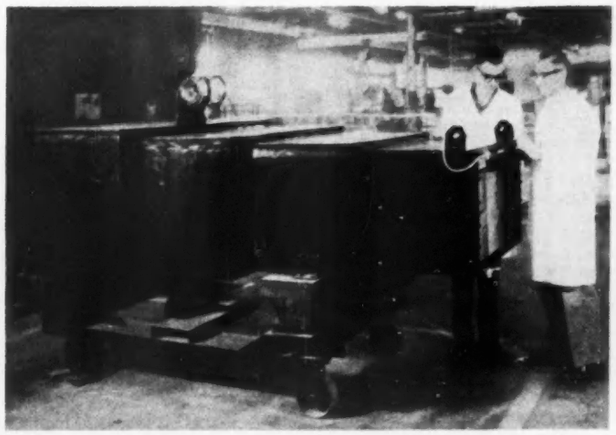


Fig. 30—8ft 6in deep radiation shielding window for the National Reactor Testing Station in Idaho

The box is designed to obtain high versatility and contains adequate space for equipment such as a furnace, a spectro-photometer, a balance, &c. Its shelves have movable supports to provide more or less working space on the floor of the glove box. The facilities within the box can include air, vacuum, hot and cold water and electrical sockets. For convenience and safety, an easy-to-operate guillotine air lock is available for use between two of these boxes. The door of the air lock is pneumatically operated and opens and closes at the touch of a lever to allow the safe transfer of material from one box to another. The glove box contains two filters and can remain in safe operation while one of the filters is replaced.

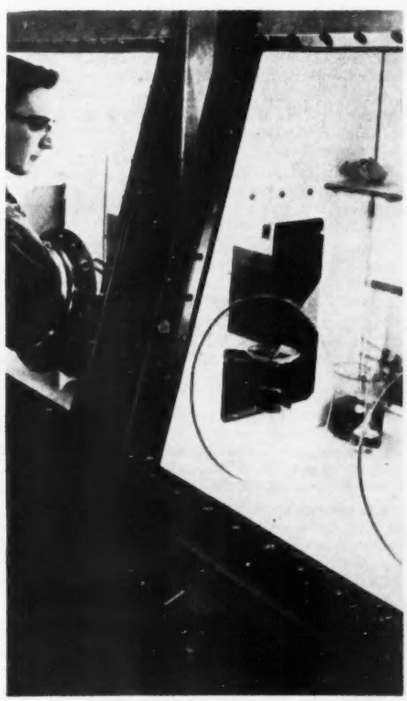


Fig. 31—Glove box, for plutonium work, made of stainless steel and laminated safety glass

Personal and Business

Appointments

MR. I. H. GORDON has been appointed assistant sales manager of Cambridge Instrument Company, Ltd.

MR. P. S. ROSSETER, London manager of Hamworthy Engineering, Ltd., has been appointed marine manager of the company.

THE MINISTRY OF SUPPLY announces that Dr. B. G. Dickins has been appointed director general of atomic weapons in succession to Mr. E. S. Jackson.

COLONEL SIR MYERS WAYMAN has been elected president of the Institution of Engineering Designers, in succession to Lord Nuffield, who has held the office for the past five years.

METAL INDUSTRIES, Ltd., announces that Mr. W. Padley, personal assistant to the chairman, has been appointed administrative controller. Mr. P. Jardine, group chief accountant, becomes group financial controller.

MR. H. G. W. CHICHESTER-MILES, chairman of the Empire Rubber Company and of Rubber Bonders, Ltd., has been elected president of the Federation of British Rubber and Allied Manufacturers for 1959–60. Mr. S. D. Sutton and Mr. C. H. M. Baker have been elected vice-presidents.

VICKERS, Ltd., states that Sir James Reid Young, having reached normal retirement age, has vacated his seat on the board of directors. Mr. W. D. Opher, M.I.Mech.E., a director of Vickers-Armstrongs, Ltd., and of certain other Group companies, and managing director of Vickers-Armstrongs (Engineers), Ltd., has been appointed an additional director.

THERMOTANK, Ltd., announces that Mr. F. McPherson and Mr. J. K. W. MacVicar have been appointed joint managing directors. Mr. I. M. Stewart, who remains chairman, has resigned the duties of managing director in view of his appointment as chairman of Hall-Thermotank, Ltd., the amalgamated company which it is proposed to form with J. and E. Hall, Ltd.

FERODO, Ltd., announces that Mr. J. D. Millner, manager of the north London branch, has been appointed the company's manager in the Irish Republic. He has been succeeded as north London manager by Mr. W. H. Wyse, whose position as Sheffield manager has been filled by Mr. A. Chatterton. Mr. T. R. Earnshaw, a director, has now assumed full responsibility for export sales, following the retirement of Mr. F. L. Harrap on May 31.

Business Announcements

JOY-SULLIVAN, Ltd., has announced the formation of an air power division, 7, Harley Street, London, W.1.

STEDALL MACHINE TOOL COMPANY has moved into more spacious premises at 192/208, Pentonville Road, London, N.1 (telephone, Terminus 3699).

MATTHEWS AND YATES, Ltd., states that it has transferred its Birmingham office to larger premises at Smithfield House, Digbeth, Birmingham, 5 (telephone, Midland 7284).

E. P. BARRUS (CONCESSIONNAIRES), Ltd., 12–16, Brunel Road, Acton, London, W.3, has been appointed sole concessionaire in the United Kingdom and Eire for Greenfield taps and dies.

SAVAGE AND PARSONS, Ltd., Watford, Herts, and Generall Mills Inc., Minneapolis, Minnesota, U.S.A., announce the formation of a new company, Nuclear Equipment, Ltd., Otterspool Way, Watford.

THE SANDIACRE SCREW COMPANY, Ltd., has opened a London office at 70, St. Stephen's House, Victoria Embankment, London, S.W.1. Mr. K. A. Ballard has been appointed as the company's London manager.

STANLEY HOWARD, Ltd., 73, Devon Street, Birmingham, 7, announces that it has been appointed sole selling agent in Great Britain for the machine tools manufactured by Eugen Weisser and Co. K.G., Heilbronn/Neckar, Germany.

BRITISH INDICATORS, Ltd., Sutton Road, St. Albans, Herts, announces that a new company, British Indicators (Sales), Ltd., has been formed and has taken over the selling functions originally discharged by British Indicators, Ltd.

THE SELSON MACHINE TOOL COMPANY, Ltd., Minerva Road, North Acton, London, N.W.10, has been appointed sole distributor of the Bruel and Kjaer surface roughness meter in the Midlands, and eastern and southern areas of England.

ASSOCIATED CHEMICAL COMPANIES GROUP has erected at its Eaglescliffe Works, a new plant for the production of sulphuric acid, with a rated capacity of 100 tons per day. The contract was placed with the Power-Gas Corporation, Ltd., Stockton-on-Tees.

KIMBELL MACHINE TOOLS, Ltd., 39, Victoria Street, London, S.W.1, announces that it has recently been appointed sole concessionaires for the United Kingdom of Fritz Schäfer G.m.b.H., Neunkirchen Kr. Siegen (Westphalia), maker of storage bins, shelves and racks.

CAMBRIDGE INSTRUMENT COMPANY, Ltd., 13, Grosvenor Place, London, S.W.1, announces that its headquarters have been extended. The publicity and accounts departments have moved back to headquarters and the premises at 60, Buckingham Palace Road have been vacated.

A.I. ELECTRIC WELDING MACHINES, Ltd., has opened new offices at Grove House, Sutton New Road, Birmingham, 23 (telephone, Erdington 1176). The company's London office has been changed to Temple Chambers, Temple Avenue, London, E.C.4 (telephone, Fleet Street 6660).

FLEXIBLE DRIVES (GILMANS), Ltd., Carlton Houes, High Street, Smethwick, Staffs, has been appointed sole distributing agent for "Tyrolit" profile grinding wheels and shapes and "Tyrolit" Secur cutting-off discs, in the United Kingdom, India, Australia, New Zealand, Eire and all colonies of the British Commonwealth.

BRYCE BERGER, Ltd., a member of Hawker Siddeley Industries, Ltd., has commenced production at a new factory site in Hucclecote, Gloucester. The vacated works at Staines are being taken over by Petters, Ltd., also part of the Hawker Siddeley Group, and will be used for the production of Armstrong Siddeley industrial engine units.

ASSOCIATED COMMERCIAL VEHICLES, Ltd., announces that its subsidiary company, A.E.C., Ltd., has acquired a substantial interest in the South African public company, J. H. Plane Africa, Ltd., of Johannesburg. A South African company is being registered to manufacture and market progressively the A.E.C. range of vehicles in the Union. Dowson and Dobson, Ltd., which has represented A.E.C. in South Africa for the last eighteen years, will transfer its distributorship to the new South African A.E.C. Company as from July 1, 1959. In the meantime, Dowson and Dobson, Ltd., will fulfil all outstanding chassis orders. Sir William Black, chairman of A.E.C., Ltd., and Mr. J. D. Slater, a director of A.E.C., Ltd., have been appointed to the board of J. H. Plane Africa, Ltd.

Contracts

ELECTRO-CHEMICAL ENGINEERING COMPANY, Ltd., a subsidiary of Efco, Ltd., has received an order from Japan to supply an electro-metallurgical plant. The contract price is stated to exceed £300,000.

NEWMAN INDUSTRIES, Ltd., has received an order for 1800 industrial, three-phase, electric motors ranging from 1 h.p. to 10 h.p. from the Lasar Manufacturing Company, Los Angeles, California. The motors are for commercial catering meat grinders and saws.

WILD-BARFIELD ELECTRIC FURNACES, Ltd., has received an order from The Mond Nickel Company, Ltd., for an induction heated vacuum melting furnace having a capacity of 112 lb of nickel-based alloys. The furnace, which is to be used for the production of experimental alloys, will be powered by a B.T.H. 125kW, 3 kc/s, vertical-spindle generator. The pumping system will comprise a 12in diameter booster diffusion pump in parallel with a 16in diameter, high-vacuum, diffusion pump, backed by a Roots mechanical booster and a rotary gas ballast pump. A holding pump will be provided to enable either, or both pumps, to be held, or used on the tank.

PARKINSON HOWARD, Ltd. (in association with Sir Lindsay Parkinson and Co., Ltd., and John Howard and Co., Ltd.) has been awarded the contract for the access roads for the Volta River Project preliminary works. The contract consists of the construction of 2 miles of road widening, 9 miles of new road to trunk road standards, 3 miles of housing layout and 4 miles of dam site construction roads. The employing authority is Kaiser Engineers and Contractors Incorporated, and the consulting engineers are Sir William Halcrow and Partners. The value of the contract is £420,000 and the work is due for completion within nine months.

MARCONI'S WIRELESS TELEGRAPH COMPANY, Ltd., and the Compagnie Générale de Télégraphie Sans Fil are receiving contracts from N.A.T.O. Governments to the value of nearly £7,000,000 for work in equipping stations in the Early Warning Chain. The contracts cover, in addition to the supply and installation of equipment, the training of national personnel and assistance in technical maintenance after hand-over of the stations in working order. The majority of the stations will consist of a combination of equipment, produced by the two companies, and while this work will be executed in partnership, the Marconi company will carry the major responsibility for system and station planning and for installation.

Miscellanea

MOTION PICTURE PROJECTION.—There is now available from the Electrical Development Association, 2, Savoy Hill, London, W.C.2, a booklet entitled "Your Film Show," describing how to put on film shows in industry or workshop. The text is simple, being concerned not with technical details so much as the arrangement of screen, seats and speaker.

GLITSCH BALLAST TRAY.—Metal Propellers, Ltd., states that a new Glitsch Ballast Tray is now available which has high capacity, high efficiency, particularly at very low to moderate vapour rates, and good flexibility, a turn down ratio of up to 9 to 1 being obtainable. It resembles a bubble cap tray but with the cap and riser assembly replaced by a unit producing constant vapour velocity through a variable annular slot, and can also be classed as a sieve tray with apertures which are sealed at zero vapour rates.

HYDROLOGICAL SURVEY OF THE RIVER GREAT OUSE.—The Ministry of Housing and Local Government announces that arrangements have been made for a survey of the water supply resources of the River Great Ouse. The Ministry's Surface Water Survey Centre will carry out a hydrological survey of the river and a small working party has been formed of the engineers advising the major water undertakings in the area and the River Board, under the chairmanship of one of the Ministry's senior engineering inspectors, to co-ordinate this survey and the investigation by the water undertakings of possible schemes for abstraction.

TRANSISTOR TESTER.—A transistor beta tester introduced by Siemens Edison Swan, Ltd., 155, Charing Cross Road, London, W.C.2, has been designed to provide an economical means of making tests sufficient for normal working purposes on all p-n-p transistors. Current gain and collector leakage are measured under common emitter conditions. Current gain (10–150) at a collector current of 0·5–4mA is read directly off a calibrated dial in conjunction with an audible signal. Leakage current is measured on a meter at a fixed collector voltage of 9V. Accuracy is 5 per cent. The beta tester is a battery-operated, transistorised unit in a die-cast alloy case, fitted with quick-release terminals.

EASTERN REGION MODERNISATION.—The Eastern Region of British Railways has published a brochure illustrating and describing in outline the principal lines of progress being followed in modernising the region's equipment and services. Motive power and rolling stock occupy the first twenty pages, after which various amenities for passenger travel are dealt with, including stations and waiting rooms conforming to current standards in architecture and decoration; and new ideas in train indicators which not only assist the passenger, but by reducing the number of queries addressed to staff, may well contribute to efficiency and to an harmonious atmosphere when problems requiring personal assistance arise. Finally, the brochure illustrates numerous mechanical aids to freight working, maintenance and general operation. The contractors supplying many of the items of equipment illustrated are quoted, thus acknowledging the important part played by the engineering industry in the modernisation programme and increasing the potential value of the brochure as a picture of British industrial enterprise.

"LIGHTNING" ROCKET PACK.—The latest issue of *This is Napier* includes in an article on the "Scorpion" rocket engine a "ghosted" drawing of a rocket pack interchangeable with the standard long-range kerosene tank of an all-weather interceptor: the resemblance to the tank of an English Electric "Lightning" extends down to the stabilising fin. The pack of skin and stringer construction attaches at two points and carries a "Double Scorpion" engine: the front part of the shell is an integral peroxide tank, and the rockets depend for kerosene on the tanks in the aircraft. What is described as a nitrogen charging connection is located on top of the back near the kerosene inlet and the electric control cables, suggesting that the pack would be exchanged for a ready-to-use one rather replenished in place on the aircraft. Fuel tankage being critically scarce on supersonic aircraft, it was not expected that the "Lightning" would be fitted with auxiliary rockets: however, the article confirms the reports of an advanced missile being developed for it by saying: "In combination with latest type air-to-air missiles this form of rocket boosting may give the now semi-obsolescent fighter a new lease of life."

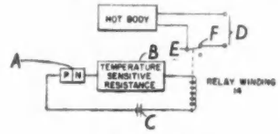
British Patent Specifications

When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings, unless otherwise stated. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification. Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 3s. 6d. each.

ELECTRONICS

811,483. April 5, 1957.—THERMALLY-OPERATED SWITCHING, Sylvania Electric Products Inc., 60, Boston Street, Salem, Massachusetts, United States of America.

According to the present invention, there is provided a thermally operated electric switching system comprising a p–n junction, a current-sensitive device and an element having a temperature-sensitive electrical resistance connected in series to an electrical power supply arranged to bias the junction in the reverse sense to such an extent that when, by reason of a variation in temperature, the resistance of the said element falls below a predetermined value, breakdown of the junction occurs and the increased current flowing in the current-sensitive device switches the device from a first state to a second state. Referring to the drawing, a series circuit includes, in the order named, a body *A* containing a p–n junction, a temperature-sensitive resistance or thermistor *B*, a relay winding and a battery *C*. A hot body, in this example an electrically operated heater, is positioned adjacent the thermistor. Electrical energy is applied to terminals *D* and is supplied from them through relay contacts *E* and *F* to the hot body. When the relay is de-energised (as in the drawing), the hot body is electrically energised ; when the relay is energised,

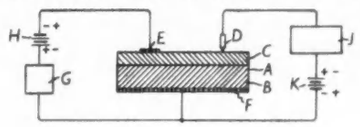


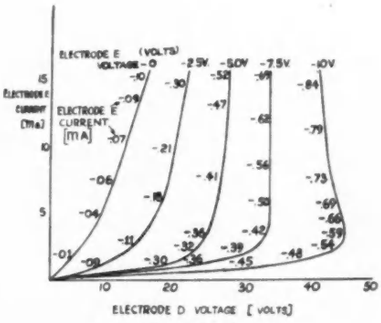
No. 811,483

electrical power cannot be supplied to the hot body. The p–n junction is biased in the reverse direction of current flow. As the temperature of the thermistor increases, there will be one temperature at which the voltage across the junction will equal the breakdown voltage and the relay will be energised. The light radiation from the hot body increases with temperature. If the body is so positioned that some of this radiation strikes the p–n junction, minority carriers will be generated. Since the breakdown voltage of the junction decreases as the number of minority carriers increases, and since the number of minority carriers increases as the radiation increases, the sensitivity and response speed of the device can be increased by utilising radiation in this manner. A semiconductor may be used in place of the thermistor, and provision may be made for controlled minority carrier injection by a point contact.—*April* 8, 1959.

811,711. June 15, 1955.—SEMI-CONDUCTOR DEVICE, General Electric Company, Schenectady 5, State of New York, United States of America.

This invention relates to semi-conductor electrical devices of the kind having two or more contacting zones of semi-conductor material of different types of conductivity. Referring to the embodiment





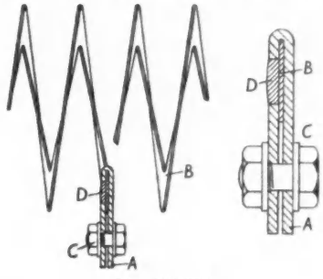
No. 811,711

shown in the upper drawing, the typical semiconductor device *A* has a body *B* of one type conductivity, and a thin layer *C* having an opposite type conductivity. Body *B* is contacted by electrodes *D*, *E*, of which electrode *D* is in rectifying contact and electrode *E* in ohmic contact with layer *C*. Electrode *F* is connected through common connection or ground to electrode *E* through input signal source *G* and d.c. source *H*. The output circuit comprises in series connection between electrodes *D* and *F*, an impedance load *J* and d.c. source *K* which serves to bias electrode *D*. Amplified reproductions of input signals impressed by signal source *G* are produced at load *J*. Referring to the lower figure there is shown a plot of the static output characteristic of a typical device as shown, using iron pyrite as the semi-conducting material. Similar results are obtained, using germanium or silicon as the body material.—*April* 8, 1959.

ELECTRICAL ENGINEERING

811,759. August 8, 1957.—ELECTRICAL RESISTANCES, E.M.B. Company, Ltd., Moor Street, West Bromwich, Stafford. (*Inventor : Stanley Smith.*)

This invention relates to electrical resistances of the kind comprising a metal strip coiled edgewise to a helical form. When the strip is made from certain varieties of stainless steel difficulties arise in attaching connecting lugs to the coil, as effective connections can only be made by a welding or brazing operation, and a consequence of this is that the portion of the strip which is heated in this operation becomes so brittle that the strip can easily be broken at the connection. To overcome this difficulty, the invention consists in the combination with the resistance strip at each position at which a connection, or so-called tapping, is to be made, of a lug made from steel or other metal strip which is folded so that it tightly embraces the resistance strip and has formed in one or each of its side parts a hole into which a quantity of brazing material is inserted, the lug and resistance strip being bonded together by fusion of the brazing material. The left hand drawing represents a portion of a helically coiled resistance strip to which is attached a connecting lug, and the right hand one is a fragmentary sectional view illustrating the mode of attaching the lug to the strip. Lug *A* is made from steel or other metal strip which is folded to form a pair of side parts which can be placed over and fit tightly the faces of the resistance strip *B*, the length of the lug

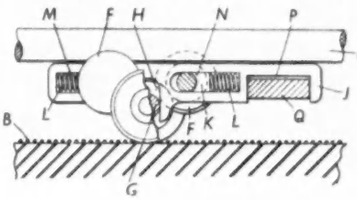


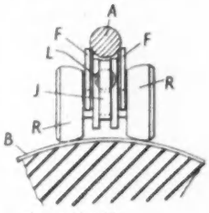
No. 811,759

being such that at one end the side parts extend sufficiently beyond one edge of the resistance strip to accommodate one or a pair of clamping bolts as *C*. In one or each of the side parts of the lug in contact with the resistance strip is formed a hole for accommodating a brazing metal *D* in powdered or granular condition. Should the part of the resistance strip which is heated in the brazing operation become brittle, this is of no consequence, as this part is effectively reinforced by the lug.—*April* 8, 1959.

812,391. June 14, 1957.—ELECTRIC CONTACT DEVICE, Gresham Transformers, Ltd., Twickenham Road, Hanworth, Middlesex, and John Osmond Morris Palmer and Basil Stoddard Palmer, both of the company's address.

This invention relates to electric contact devices for regulating transformers, reactors, resistors or the like, in which a contact roller unit comprising a pair of rollers on a supporting spindle is adapted to be moved by a guide member along straight paths parallel with the longitudinal axis of a helical coil of wire. In the illustrated example a guide bar *A* is parallel to but spaced apart from the periphery of a helical coil winding *B* of bare wire on a cylinder of insulating material. Between the guide bar and the coil is a carriage with a pair of horizontal slots accommodating the spindles of two pairs of rollers *F*, the peripheries of which bear against the under-side of the guide rod *A*. The peripheries of these rollers also bear against a spindle *G* serving to connect rigidly together two further rollers (*R* in the lower drawing) which constitute the contact rollers resting upon the periphery of the coil. The spindle is disposed in a vertical notch *H* in the carriage *J*. The spindles of the guide rollers *F* are urged towards each other by sliding blocks, one of which is seen





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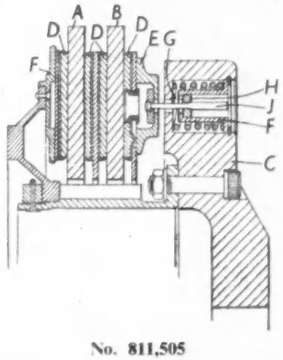
at *K*, by helical compression springs *L* disposed in the slots *M*, *N*, in the carriage and the carriage is furnished with a notch *P* for engagement by an operating bar *Q*. The forces exerted by the springs *L* give a resultant force on the contact rollers at right angles to the axis of the guide bar and substantially constant pressure is exerted on the coil throughout the movement of the carriage, notwithstanding that the distance of the guide rod from the coil periphery may be varied to some extent.—*April* 22, 1959.

BRAKES

811,505. August 13, 1956.—AUTOMATIC ADJUSTING DEVICE, FOR BRAKES AND CLUTCHES, Dunlop Rubber Company, Ltd., 1, Albany Street, London, N.W.1. (*Inventor : Henry William Trevaskis.*)

This invention relates to a device for automatically adjusting brakes, clutches and like mechanisms. In the form shown, the automatic adjusting device is associated with an aircraft disc brake of the type comprising a pair of axially spaced, axially-slidable discs *A*, *B*, rotatable by a landing wheel (not illustrated), a non-rotatable torque plate *C* and non-rotatable pads *D* on each side of the discs. A fluid-pressure operated mechanism (not illustrated) associated with the torque plate moves a pressure plate *E* and forces the assembly in frictional engagement against a rigid backing plate *F* to brake the wheel. As can be seen, the torque plate has a cylindrical recess and a flanged bush *F* slidable in this recess is spring-loaded towards the open end to leave a gap *G* between its inner end and the foot of the recess. This gap represents the combined clearance between the friction pads *D* and the discs, when the brake is inoperative. A button-type wire drawing die *H*



No. 811,505

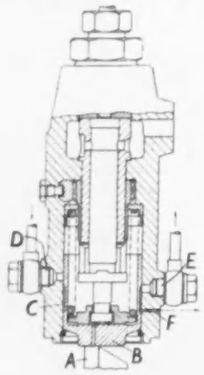
fits in the bore of the bush and is held by a step at its inner end. A wire element *J* of known tensile strength has a length of reduced diameter, which passes through the die bush, the end of the torque plate recess and a hole in the pressure plate *E*. Inside the pressure plate the end of the element is anchored. On operating the brake the pressure plate *E* is moved to effect frictional engagement between the discs and friction pads, and movement of the pressure plate *E* acting through the wire element and the die, moves the bush in the same direction against its associated spring until the brake is fully engaged or until the end of the bush bottoms on the base of the recess in the torque plate. If the bush bottoms in the recess before the brake is fully applied, due, e.g. to wear of the friction pads, then the operating pressure will " draw " the wire element

through the die, to lengthen the smaller diameter portion to an extent sufficient to allow the brake to be fully applied. On removing the braking pressure, the spring moves the bush back to its original position in the recess and in this position the inner end of the bush is spaced the predetermined distance from the base of the recess. The wire element, now slightly lengthened to compensate for the wear of the friction pads, draws the pressure plate away from the discs, to effect a constant running clearance between the discs and the pads. Thus, as the friction pads wear, on applying the brake, so the wire element which connects the retractor spring with the pressure plate progressively lengthens to compensate for wear.—*April* 8, 1959.

INTERNAL COMBUSTION ENGINES

812,214. January 1, 1957.—STARTING MEANS FOR INJECTION-TYPE INTERNAL COMBUSTION ENGINES, Maschinenfabrik Augsburg-Nurnberg A.G., 7, Stadtbachstrasse (13b), Augsburg 2, Germany.

This relates to starting means for diesel engines having a distributing slide valve operated by the fuel pump drive to control a pneumatically operable starting air valve. Referring to the drawing, the fuel pump for an injection type engine includes a casing in which is arranged in known manner a pump cylinder and piston. The pump piston is actuated in known manner by a cam *A* and guide



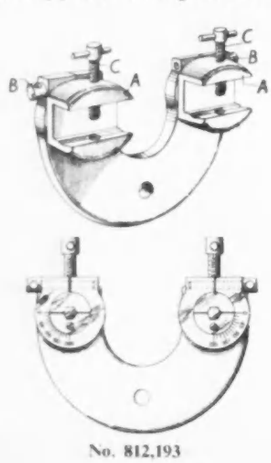
No. 812,214

sleeve *B*, either directly (as shown) or indirectly. The guide sleeve has an annular groove *C* which co-operates with two bores *D* and *E* in the casing. The bore *D* is connected to a control air pipe, and the bore *E* is connected through a supply pipe to operate the piston actuating the starting valve. On starting the engine, with the piston in a suitable position in the pump cylinder, the control air passes through *D* and by way of the annular groove into the pipe of *E* and causes the lifting of the actuating piston for the starting valve. This valve is then opened and permits the passage of starting air to the associated cylinders of the engine. When the cam is moved so that the guide sleeve covers the bore *D*, the supply pipe to *E* which is under pressure and which leads to the starting valve is vented through a bore *F* and the valve is closed.—*April* 22, 1959.

CLAMPS

812,193. March 18, 1957.—CLAMPS, Speed Tools, Ltd., Vereker Buildings, Gresse Street, London, W.1. (Communication from John Spotton Company, Ltd., 21, Carson Street, Toronto 14, Canada.)

This invention relates particularly to clamps for holding rods, pipes, bars, tubing and the like rigidly



No. 812,193

in position at a predetermined angle. The clamp comprises a U-shaped base member having the ends thickened to form a pair of bosses in each of which an element holding device or clamp *A* is rotatably mounted. Each boss is slotted at the top to form a bifurcated bearing in which the clamps can be locked in any desired position by bolts *B*. Each clamp is of channel section and has a shaft portion extending through the base member. The shaft has a disc on its outer end to prevent the withdrawal of the clamp. The outer surface of each disc is marked with a line which co-operates with an angular scale on the surface of the base so that predetermined angles can be selected for each holding clamp. Preferably the scales are marked so as to indicate the angle between the two holding clamps so that elements to be secured together can be set at desired angles. Each clamp has a screwed rod *C* in one side for holding an element. In operation the ends of two elements to be welded together are firmly held one in each of the clamps positioned on the base member at the desired angles and the screws *B* are tightened to hold the clamps rigidly in this position. It will be appreciated that the clamp provides a rigid arrangement which will hold the elements together at any desired angle from 0 deg. to 180 deg. while they are being connected together.—*April* 22, 1959.

Launches and Trial Trips

MALOJA, oil tanker ; built by by Smith's Dock Company, Ltd., for the Charter Shipping Company, Ltd. ; length between perpendiculars 533ft, breadth moulded 71ft 3in, depth moulded 39ft 2in, deadweight 18,750 tons on 30ft draught, service speed 14½ knots ; twenty-seven cargo oil tanks, one main cargo pump room, four 300 tons per hour turbine-driven pumps ; two 450kW turbine-driven alternators, one 200kW diesel-driven alternator ; one set of Hawthorn Leslie double-reduction geared turbines, 7500 service shaft horsepower at 100 propeller r.p.m., 8250 maximum shaft horsepower, steam supplied at 530 lb per square inch and 800 deg. Fah. by two Foster-Wheeler E.S.D. boilers. Launch, April 23.

ALNCO, oil tanker ; built by Joseph L. Thompson and Sons, Ltd., for Shell Tankers, Ltd. ; length between perpendiculars 534ft, breadth moulded 71ft 10in, depth moulded 38ft 6in, deadweight 18,800 tons on 29ft 8in draught ; thirty-three cargo oil tanks ; one set of Parsons double-reduction geared turbines, 7500 service shaft horsepower at 100 propeller r.p.m., service speed 14½ knots. Launch, April 23.

REGENT FALCON, oil tanker ; built by the Furness Shipbuilding Company, Ltd., for John I Jacobs, Ltd. ; length between perpendiculars 525ft, breadth moulded 71ft, depth moulded 39ft 3in, draught 30ft 7½in, deadweight 18,000 tons ; nine treble cargo oil tanks, one main cargo pump room, three 700 tons per hour vertical centrifugal pumps, two 150 tons per hour vertical duplex stripping pumps, and two 200 tons per hour pumps ; two steam-driven and one diesel-driven 100kW generators ; Wallsend-Doxford six-cylinder single-acting, two-stroke, opposed piston oil engine arranged to burn heavy fuel, 6900 b.h.p. at 116 r.p.m. Launch, April 23.

RISDON, bulk ore carrier ; built by Alexander Stephen and Sons, Ltd., for the Union Steam Ship Company of New Zealand ; length 335ft, breadth 51ft 6in, depth 25ft 6in, deadweight 5000 tons ; twelve derricks service three hatches, electric deck machinery ; 6SD.60 Stephen-Sulzer diesel engine, six cylinders 600mm diameter by 1040mm stroke, 2410 service horsepower at 128 r.p.m., 3000 h.p. at 150 r.p.m. Launch, April.

Catalogues and Brochures

G. HUNTER (LONDON), Ltd., 80, Fenchurch Street, London, E.C.3.—General handling catalogue covering cranes, hoists, lifting tackle, jacks, conveyors, stackers, fork trucks, pallets and stillages. The catalogue is illustrated.

BRITISH RESIN PRODUCTS, Ltd., Devonshire House, Piccadilly, London, W.1.—Technical bulletin on "Rockite K.501" polyester dough moulding compound, giving comprehensive information on properties, methods of moulding and finishing.

VULCASCOT (GREAT BRITAIN), Ltd., 87/89, Abbey Road, London, N.W.8.—Illustrated leaflet giving details of a rubber conduit strip for the protection of leads crossing floors. Trolleys and vehicles may be safely driven over the protective strip. It is available in maximum lengths of 30ft.

RANSOME AND MARLES BEARING COMPANY, Ltd., Newark-on-Trent. Comprehensive catalogue, containing 128 pages, describing the company's products. Sections are included dealing with rigid ball journals ; self-aligning ball journals ; adaptor sleeve ball journals ; double-purpose, Duplex and Magneto bearings ; rigid roller journals ; self-aligning roller journals ; needle roller bearings ; thrust bearings ; ball bushings, aircraft and fine-shaft bearings ; and balls and rollers.

CROFTS (ENGINEERS), Ltd., Bradford, 3.—Publication No. 858, "Fabricated Steel Conveyor Pulleys" ; No. 5833, "Stationary Field Magnetic Clutch" ; No. 5923, "Magnetic Clutches and Brakes" ; No. 5927, "Power Grip Timing Belt Drives" ; No. 5922, "Emergency Slipping Devices" ; No. 658, "Combined Spur and Worm Double Reduction Geared Motors" ; No. 5921, "'Multispeed' Geared Motor Units and Reduction Gears" ; No. 5914, "Worm Geared Motors" ; No. 5916, "'Croft-Ring' Flexible and Resilient Couplings."

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office not later than a fortnight before the meeting. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

ANTIQUARIAN HOROLOGICAL SOCIETY

Thurs., June 18.—Science Museum, South Kensington, London, S.W.7, "American Clocks 1780–1840," D. K. Packard, 7 p.m.

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS

Tues., June 16.—EAST KENT BRANCH : County Hotel, Canterbury, Branch Annual General Meeting, 7.30 p.m.
Wed., June 17.—LUTON BRANCH : Luton Chamber of Commerce, George Street West, Luton, "Contactor Gear Maintenance," 8 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS

Wed. to Sun., July 1 *to* 5.—Cavendish Laboratory, Cambridge, 1959 Convention "Television Engineering in Science, Industry and Broadcasting."

COMBUSTION ENGINEERING ASSOCIATION

Thurs., June 25.—SOUTHERN REGION : St. Ermins Hotel, Westminster, London, S.W.1, Brains Trust on "The Working of the Clean Air Act," chairman, D. G. S. M. Osborne, 10.30 a.m.

INSTITUTE OF NAVIGATION

Fri., June 19.—Royal Geographical Society, 1, Kensington Gore, London, S.W.7, "Shiphandling in Ice and Ice Navigation," H. C. Petersen ; "The Role of Inertial Methods in Hybrid Systems of Navigation," D. E. Adams, 5 p.m.

INSTITUTION OF CIVIL ENGINEERS

Wed., June 17.—Great George Street, Westminster, London, S.W.1, Conversazione, 7.30 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS

Mon. to Fri., June 15 *to* 19.—Summer Meeting at Harrogate.

INSTITUTION OF MECHANICAL ENGINEERS

Mon. to Fri., June 29 *to July* 3.—Summer Meeting in Switzerland.

INSTITUTION OF PRODUCTION ENGINEERS

Thurs. and Fri., June 18 *and* 19.—Palace Hotel, Buxton, Joint Conference to be held in conjunction with the Institution of Engineering Inspection and the British Productivity Council, "Quality in Industry."

INSTITUTION OF PUBLIC HEALTH ENGINEERS

Fri., June 19.—Caxton Hall, Westminster, London, S.W.1, Annual General Meeting, 4.45 p.m., and "New Headworks and Reservoir, Hanningfield," W. C. Young and G. Davis, 6 p.m.

PHYSICAL SOCIETY

Thurs., June 18.—ACOUSTICS GROUP : Physics Department, Imperial College of Science and Technology, Imperial Institute Road, South Kensington, London, S.W.7, "Problems in the Modern Lightweight Building—Acoustic Privacy *v.* Planning Flexibility," R. B. Newman, 5.30 p.m.
Thurs., July 2.—OPTICAL GROUP : Atomic Weapons Research Establishment, Aldermaston, Berks, All-day meeting devoted to the subject of "High-Speed Photography," 10.30 a.m.

ROYAL INSTITUTION OF CHARTERED SURVEYORS

Tues. to Sat., June 23 *to* 27.—The University, St. Andrews, Scotland, Third Annual Conference.

UNIVERSITY OF CAMBRIDGE

To-day, June 12 *to Fri., June* 19.—Engineering Laboratory, University of Cambridge, Trumpington Street, Cambridge, Exhibition to commemorate the Centenary of the death of Isambard Kingdom Brunel, 9 a.m. to 5 p.m. ; Sats., 9 a.m. to 12 noon.

Advanced Engineering Courses

Techniques of Non-Destructive Testing. PHYSICS DEPARTMENT, BRUNEL COLLEGE OF TECHNOLOGY, Woodlands Avenue, Acton, London, W.3. Course of ten lectures, Wednesday evenings from 7 p.m. to 8.30 p.m., commencing October 7. Fee £1.

Postgraduate Course in Nuclear Technology (Chemical). IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY, South Kensington, London, S.W.7. The object of the course is to provide a general training in the chemical and metallurgical aspects of nuclear technology, interpreted in a wide sense. The course is intended for graduates in chemical engineering, chemistry and metallurgy, and is also available to suitably qualified applicants from industry. It is full-time and of one year's duration, starting in October. Fee £64.

Road Materials and Construction. ROAD RESEARCH LABORATORY, Harmondsworth, Middlesex. Lecture courses will deal with the fundamental properties of road materials, and with the results of research and their application in modern practice. Courses will be held as follows : "Concrete," September 29 to October 8, Course No. 29C ; October 13 to October 22, Course No. 30C ; "Bituminous (Including Tar) Materials," October 26 to November 6, Course No. 29B ; November 9 to November 20, Course No. 30B ; "Soil Mechanics," November 24 to December 1, Course No. 29A ; December 8 to December 15, Course No. 30A. Fee for each course 12 guineas.

"Pre-Determined Motion Time Systems—II, Work Factor," INSTITUTE FOR ENGINEERING PRODUCTION, UNIVERSITY OF BIRMINGHAM, "Southfield," 16, Norfolk Road, Edgbaston, Birmingham, 15. Residential executive course, June 22 to July 10. Fee 105 guineas.

The Use of Films in Work Study. INSTITUTE FOR ENGINEERING PRODUCTION, University of Birmingham, "Southfield," 16, Norfolk Road, Edgbaston, Birmingham, 15, Residential executive course, July 13 to 17. Fee 33 guineas.

Queueing Theory and Practice. INSTITUTE FOR ENGINEERING PRODUCTION, University of Birmingham, "Southfield," 16, Norfolk Road, Edgbaston, Birmingham, 15, Residential executive course, June 29 to July 3. Fee 33 guineas.

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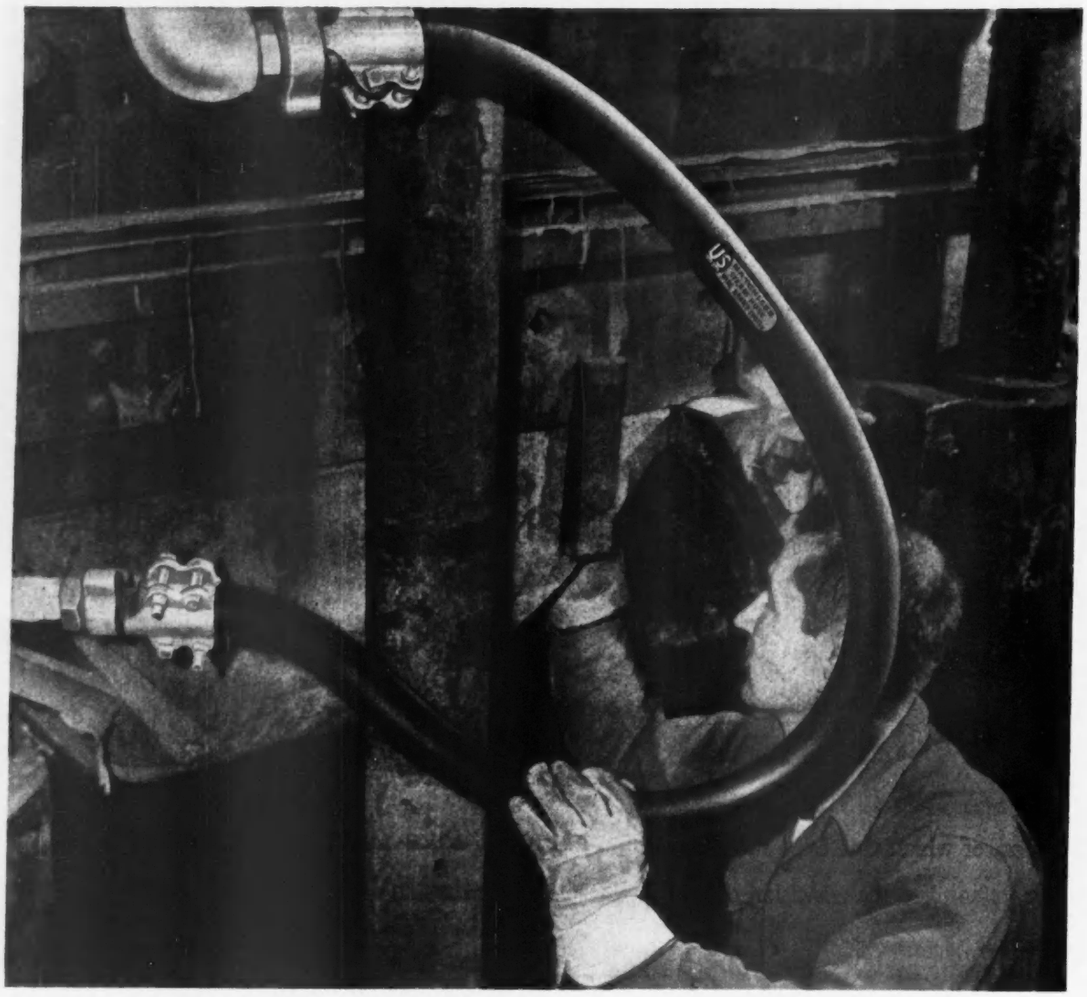

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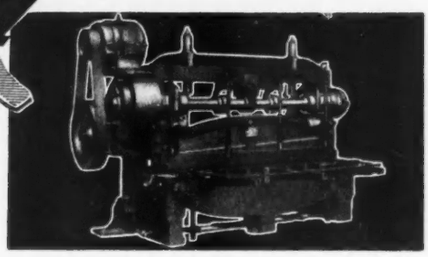

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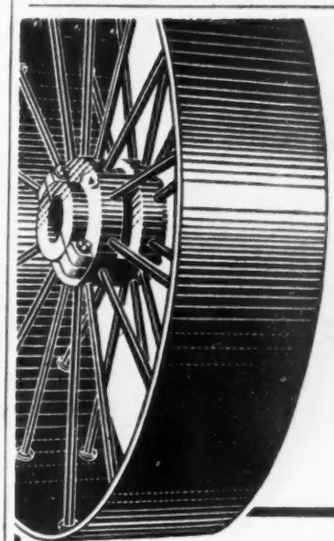

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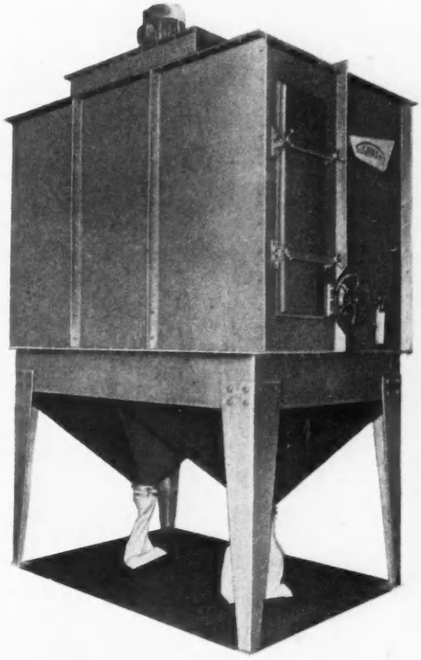

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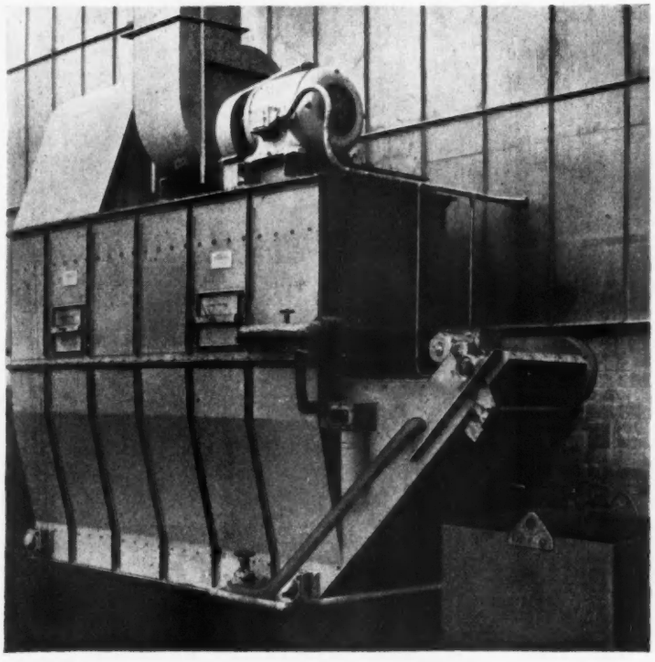

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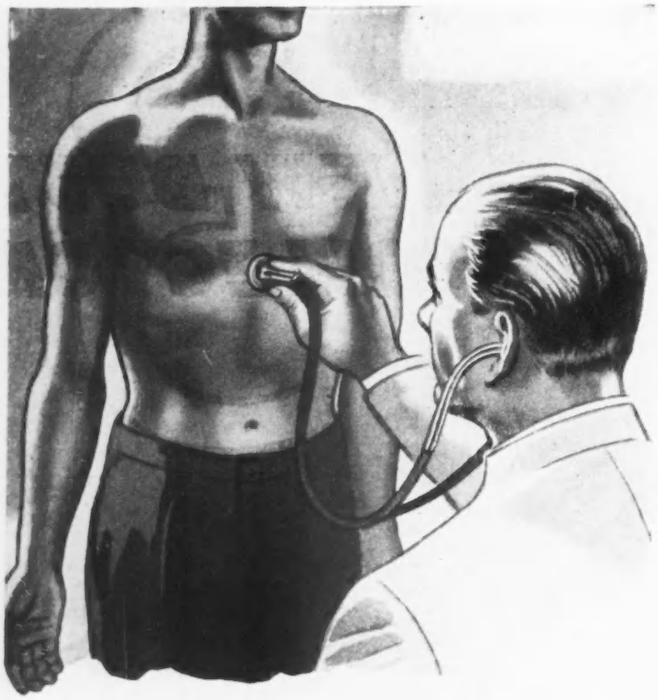

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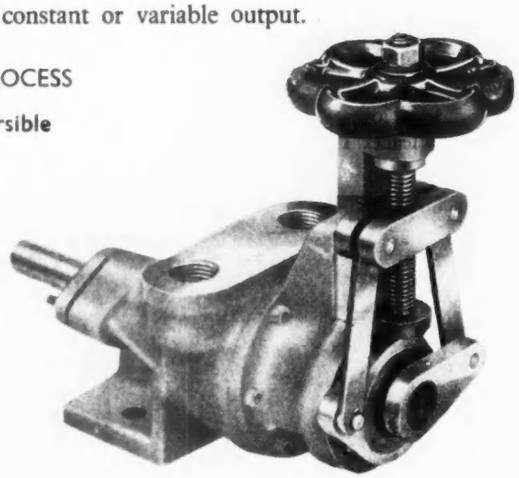

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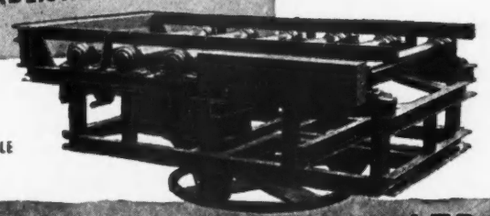

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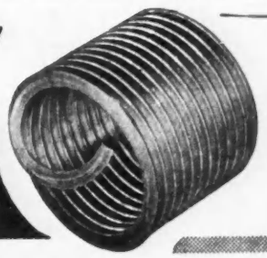

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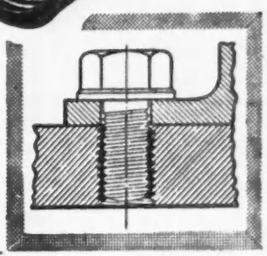

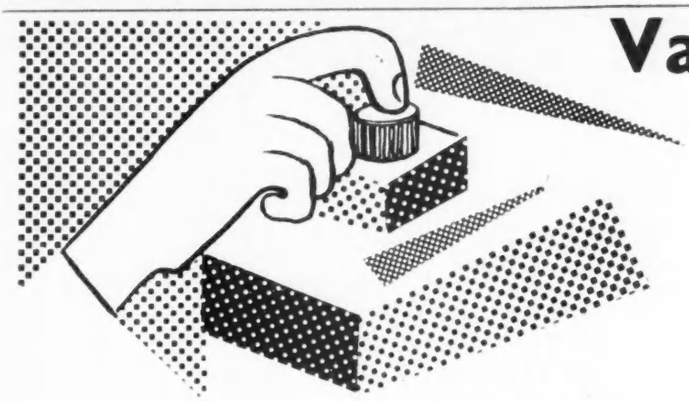

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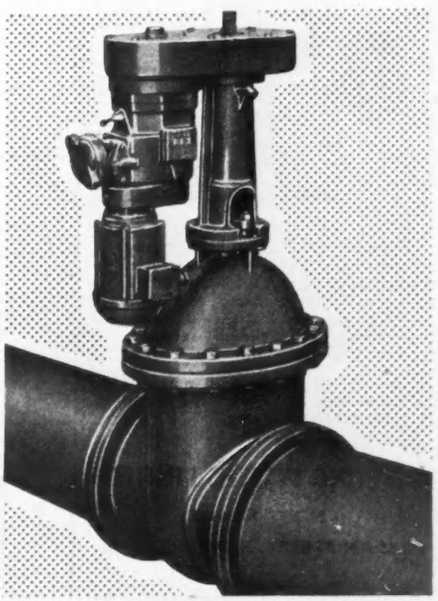

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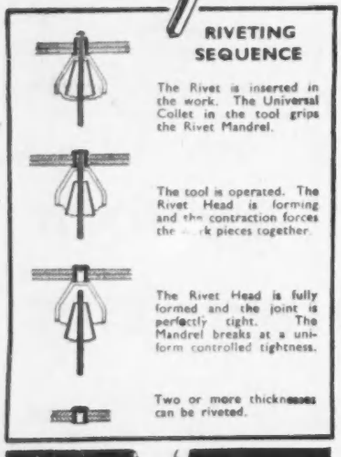
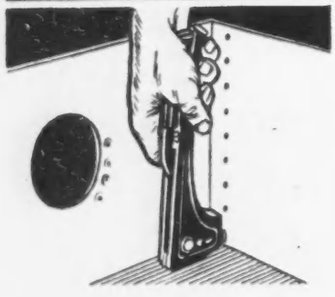

RIVETING SEQUENCE
The Rivet is inserted in the work. The Universal Collet in the tool grips the Rivet Mandrel.
The tool is operated. The Rivet Head is forming and the contraction forces the work pieces together.
The Rivet Head is fully formed and the joint is perfectly tight. The Mandrel breaks at a uniform controlled tightness.
Two or more thicknesses can be riveted.



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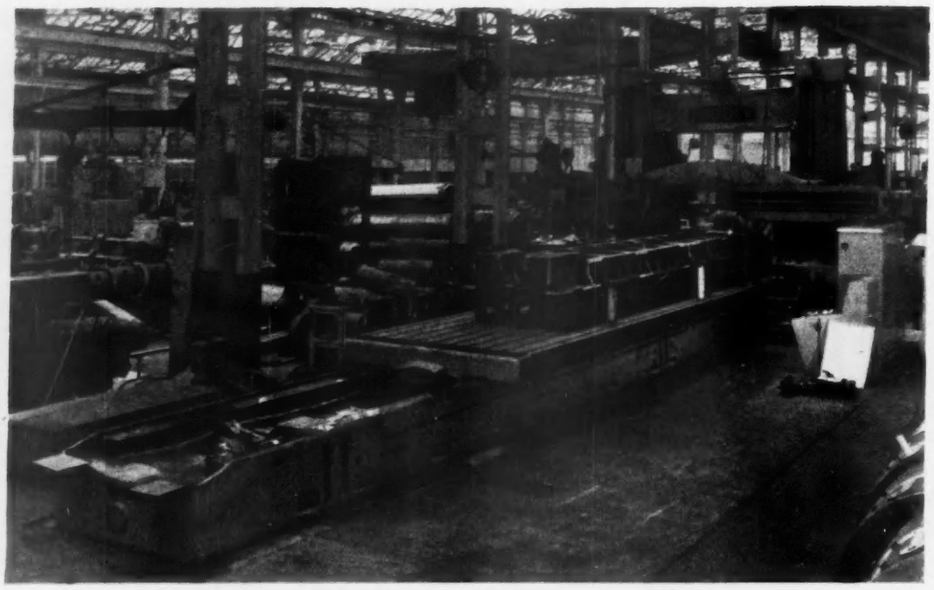

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A 9 ft. × 8 ft. × 40 ft. Planer in the Glasgow Works of Messrs. British Polar Engines Ltd., by whose kind permission it is shown, machining a cast iron 8-cylinder diesel engine bed plate. The top surface is pianed; also, by means of a special radius tool, the bearing seats. Tungsten Carbide Tools are used.

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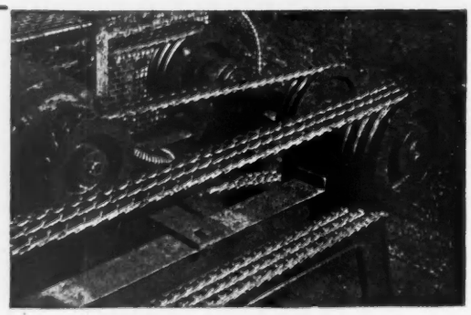

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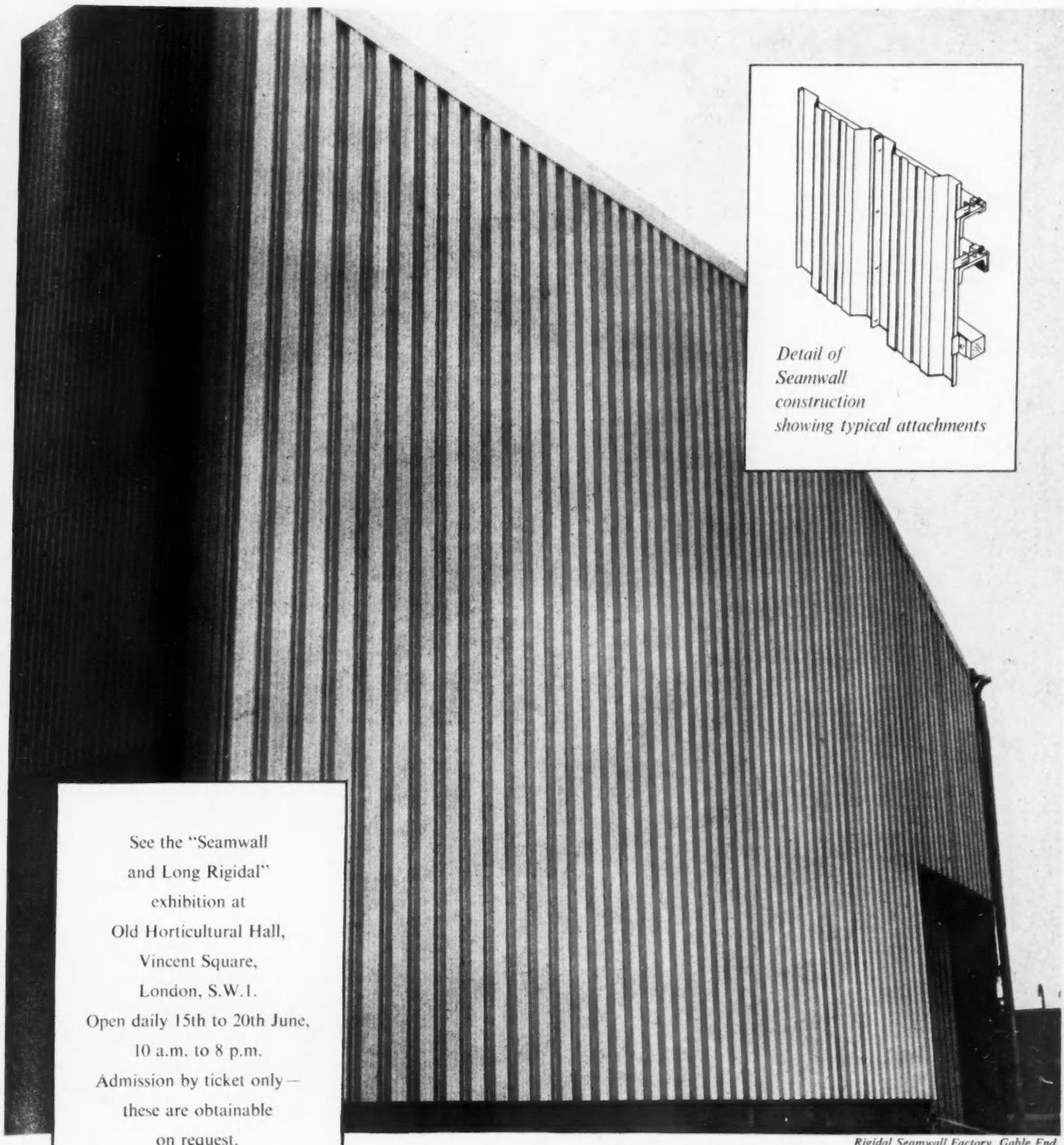

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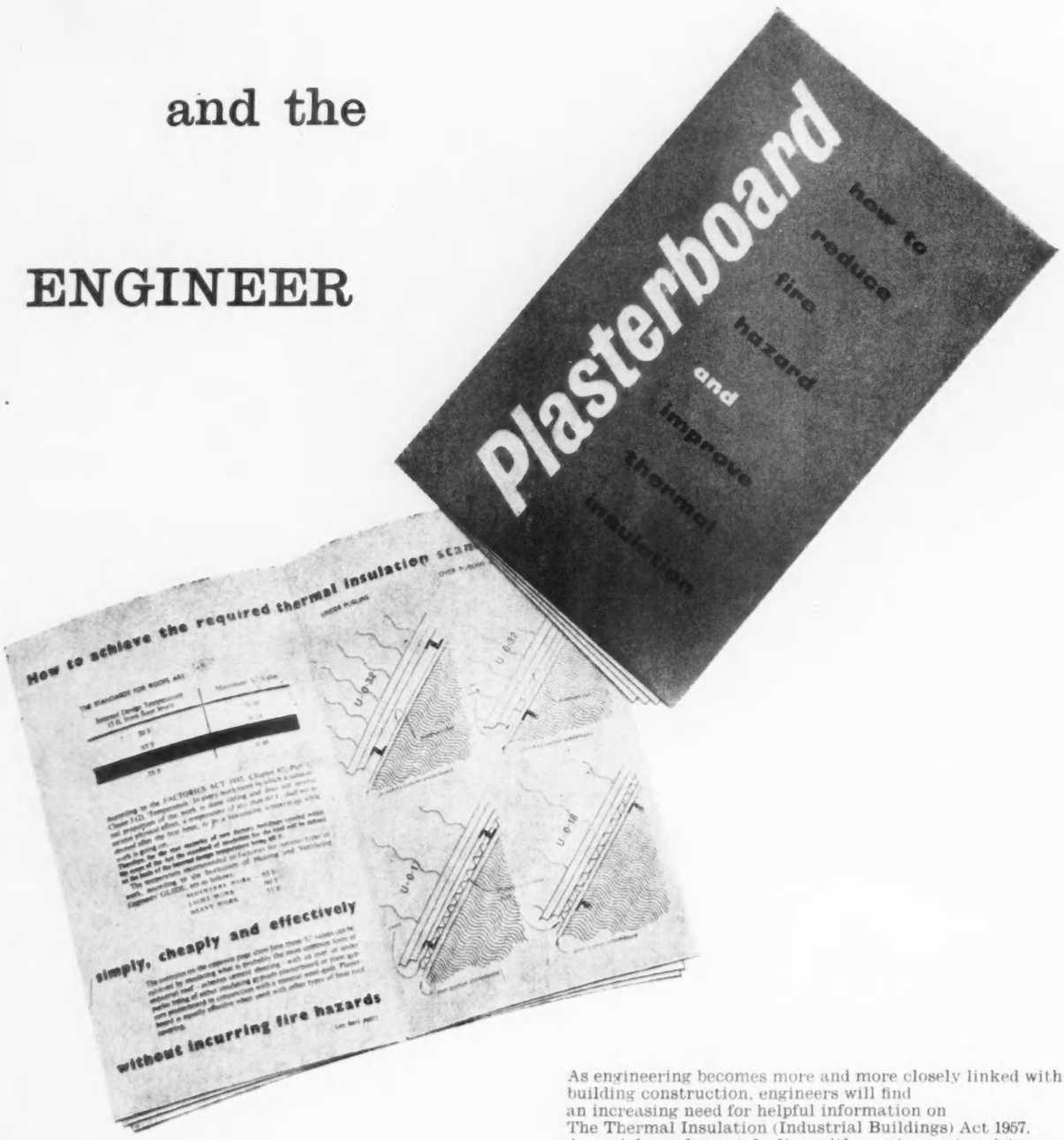
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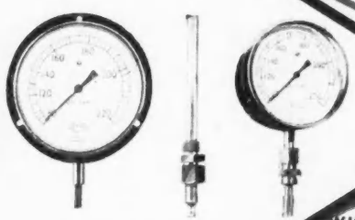

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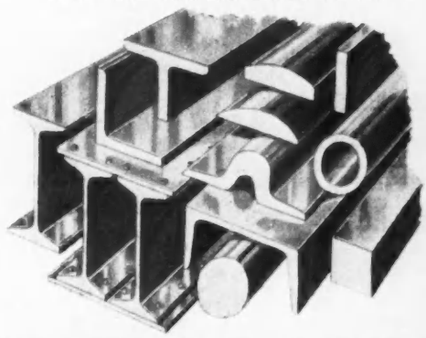

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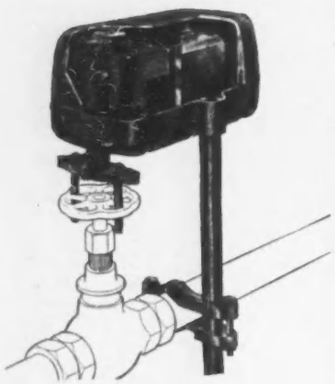

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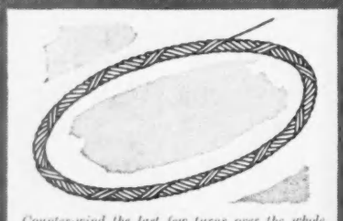

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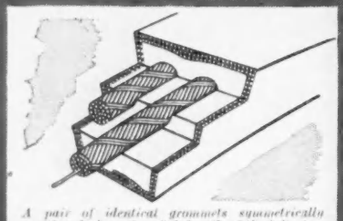

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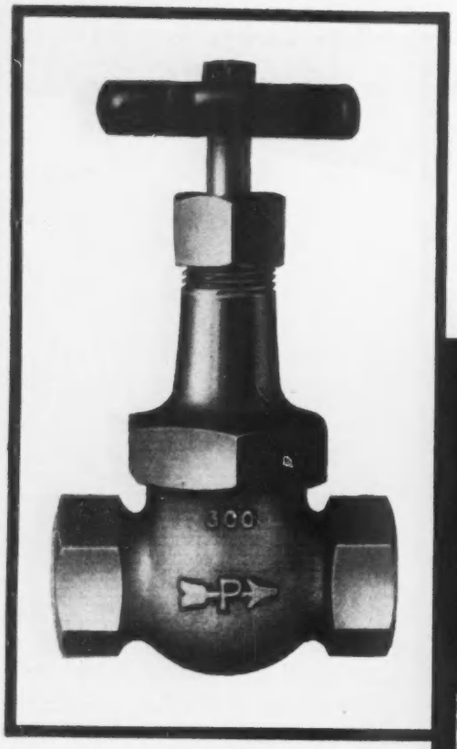

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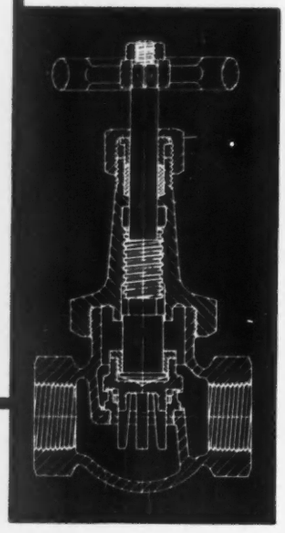

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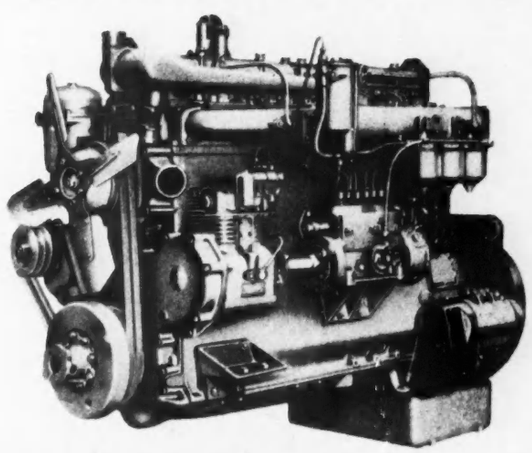

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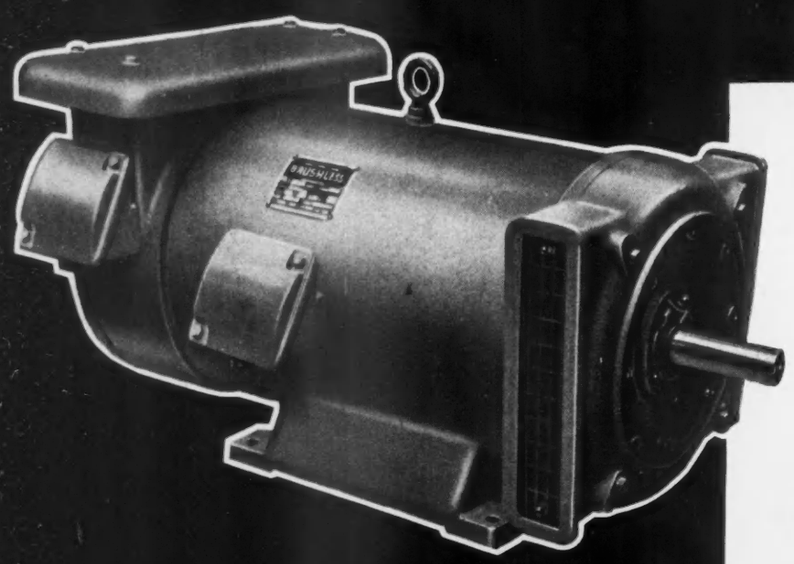

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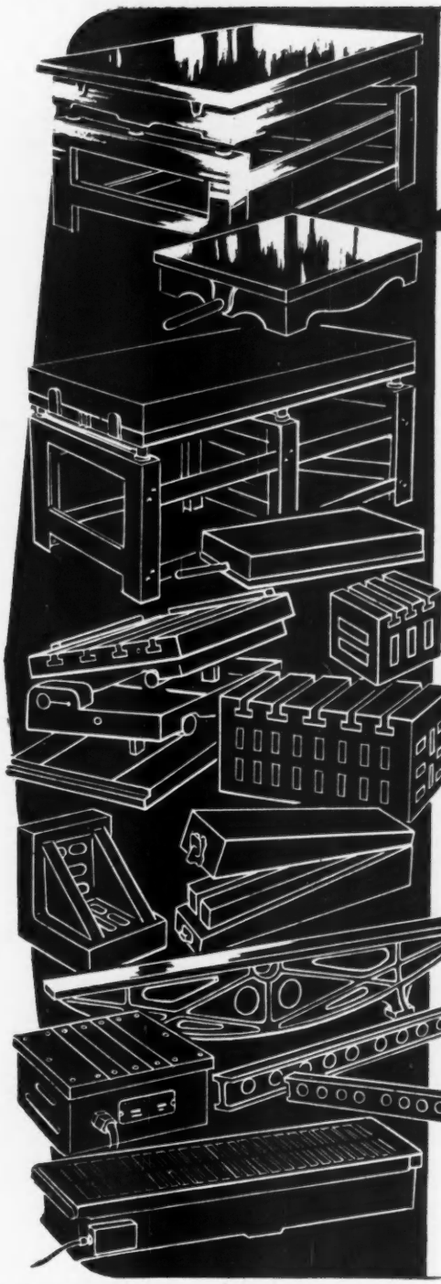

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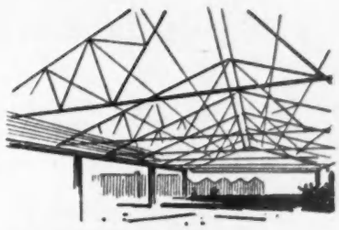

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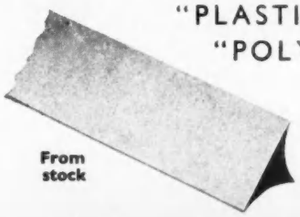

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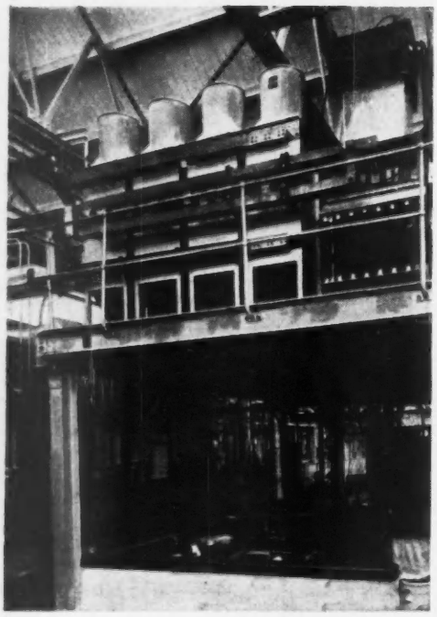
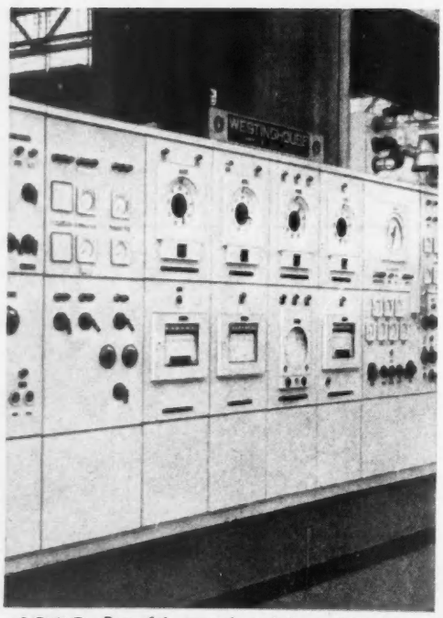


1936 *Part of a 50 000 ampere copper-oxide rectifier installation at Joseph Lucas Ltd.*



1958 *Part of the control panel of one of the electro-tinning lines of The Steel Company of Wales Ltd., Velindre, employing 450 000 amperes of water-cooled Westalite rectifiers.*

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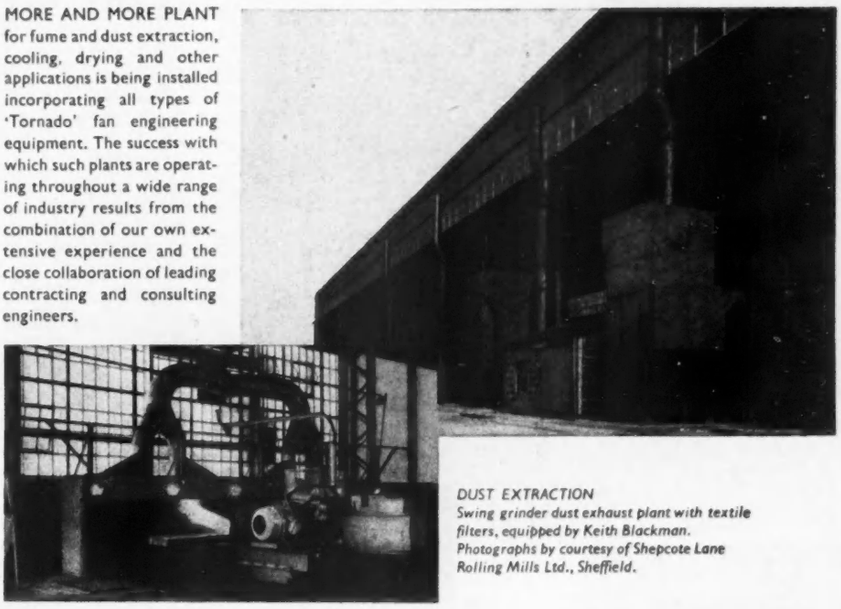

DUST EXTRACTION
Swing grinder dust exhaust plant with textile filters, equipped by Keith Blackman. Photographs by courtesy of Shepcote Lane Rolling Mills Ltd., Sheffield.

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all sizes from ¼" to 3" whit.

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with hardened and ground tooth flanks for—

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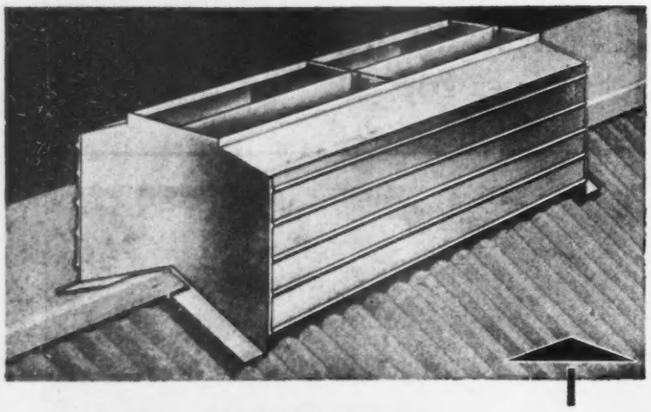
Maximum Ventilation without mechanical aid



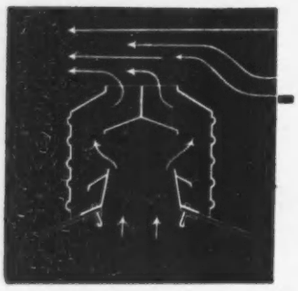
THE NEWRIDGE VENTILATOR

Without mechanical aid the Newridge gives maximum air extraction under any weather conditions!

Special baffles create air jumps, to aid stack action with natural outflow of air. Controlled exhaust can be provided during cold weather.

The Newridge Ventilator, constructed from Aluminium Alloy (1·25% manganese B.S. 1470 : 1948. N.S.3), is light in weight and corrosion resistant.

EASILY FITTED TO ANY TYPE OF ROOF



Maximum Air Extraction
The diagram of a cross-section of the ventilator shows how "stack action", assisted by the wind, forces foul air from the building.

Free Technical Advice
We shall be pleased to place our many years of technical and practical experience at your disposal without any obligation on your part.

NEWRIDGE ENGINEERING COMPANY LIMITED

Belville Works, Ponteland, Newcastle upon Tyne
Telephone: Ponteland 3170

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We specialise in REINFORCED CONCRETE & STRUCTURAL STEEL CONSTRUCTION

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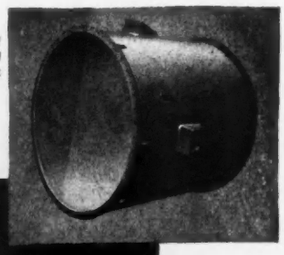
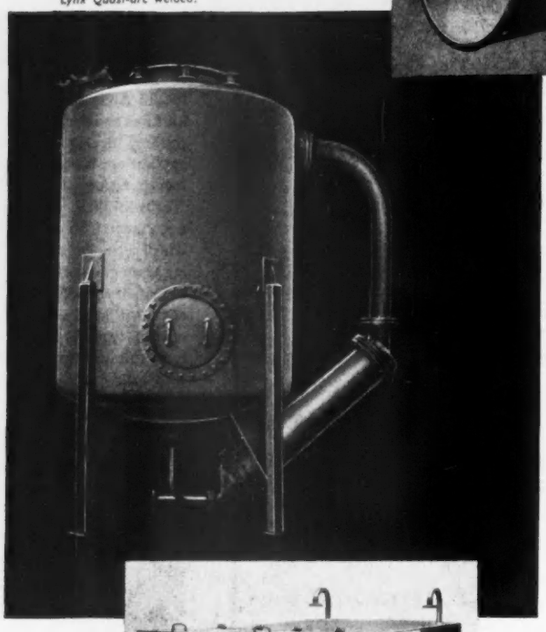
Stainless steel vessel with mild steel jacket



1,000 gall. kettle in ¼" copper. Lynx Quasi-arc welded.



12,000 gallon water separator

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Argonaut and Argon-arc Welding

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Clark's modern methods, efficient equipment, unique facilities and practical approach all operate to your advantage....

Clarks offer you a unique combination of the most advanced equipment and methods with a century-old reputation for high craftsman standards on every type of fabrication work.

Stainless steel, mild steel, aluminium, copper; and aluminium-bronze to mild steel... Clarks of Hull will not only give you the practical solution to your problem—they'll deliver a first-class job on time!

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Telephone 37654 *Telegrams 'Clark Hull'*
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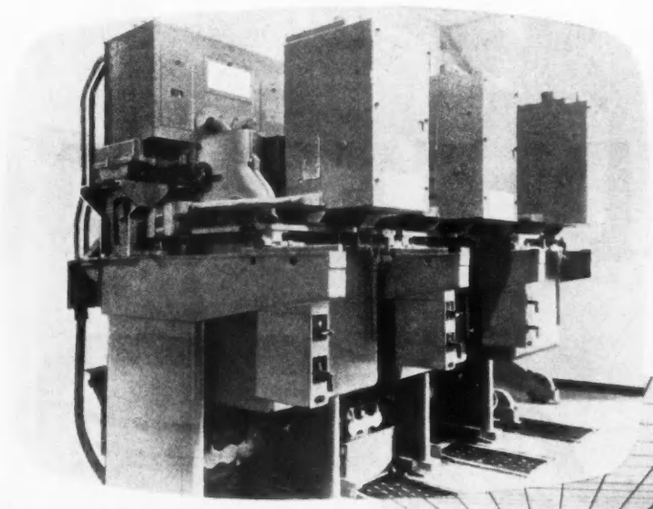
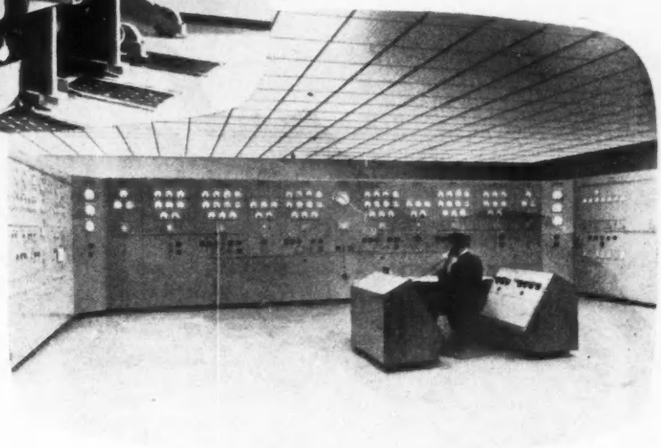
BCA



generator switchgear at Calder Hall



Photographs by courtesy of the U.K.A.E.A

The generators at the Calder Hall Power-station of the Atomic Energy Authority are controlled by Reyrolle 11-kV 500-MVA and 750-MVA switchboards and their associated control-boards

Reyrolle equipment is also installed at:

Capenhurst,

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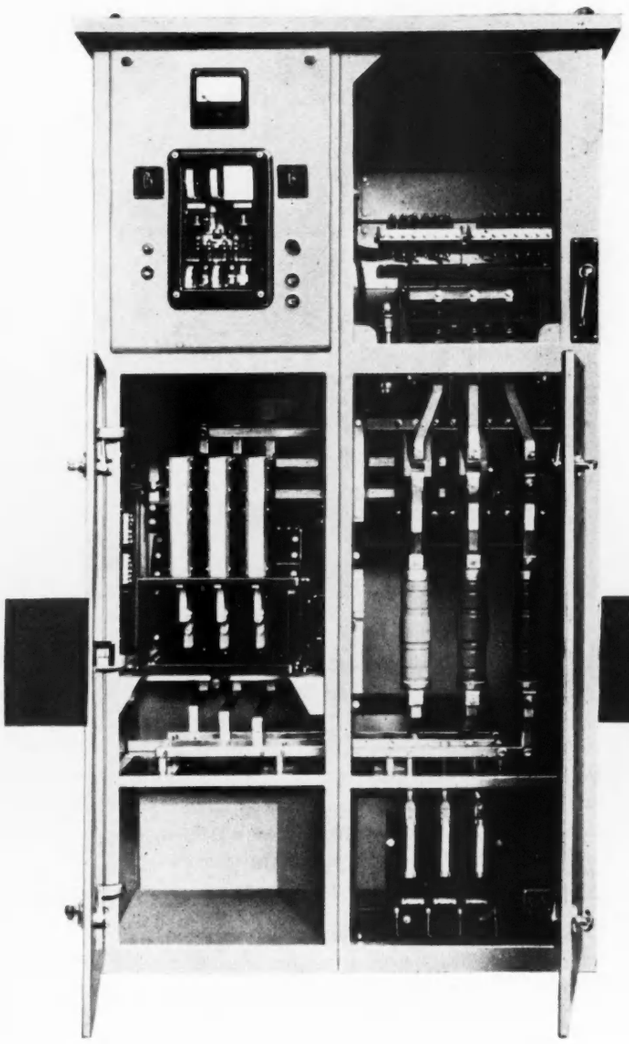
8/44

THE BELMOS 3·3 kV AIR-BREAK CONTACTOR STARTER

Rigorously tested in the Company's own research laboratory, the type K contactor starter is the latest product of the Belmos development team and continues the well-established Belmos tradition of good design and reliability. Suitable for the direct-on-line starting of 3·3 kV motors up to 600 h.p., it can be housed in a free-standing pillar or grouped with similar units to form a switchboard.



- ★ Air-break contactor rated at 150 amperes. Breaking capacity of 1,300 amperes at 3·3 kV, 0·25 power factor.
- ★ DC operating magnet supplied from 3,300/110 volt transformer within the pillar.
- ★ Reversing or Earthing isolator, mechanically and electrically interlocked, with 12 auxiliary switches, AC or DC.
- ★ Busbars designed to withstand 150 MVA for 3 seconds.
- ★ Optional earth leakage protection.
- ★ Comprehensive control arrangements, local and remote, with sequence interlocking and automatic sequence starting.
- ★ Provision for auxiliary services, such as brake protection, local lighting, etc.

the type K starter is fully described and illustrated in leaflet J 240 which is available on request.

Belmos

the Belmos company limited

BELLSHILL · LANARKSHIRE

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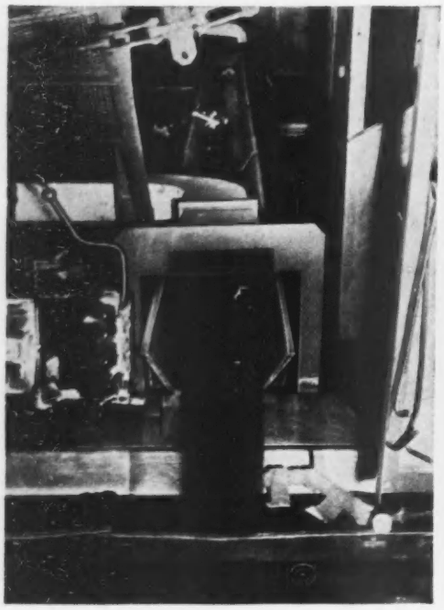
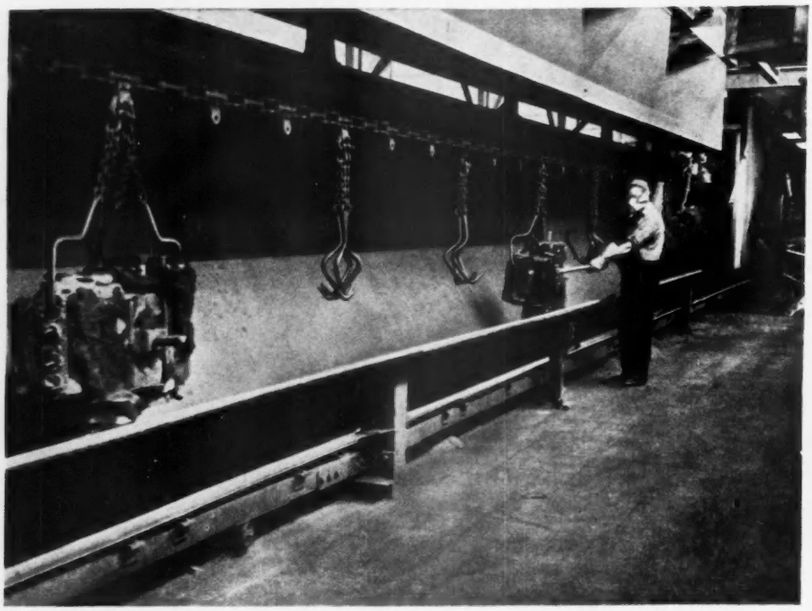
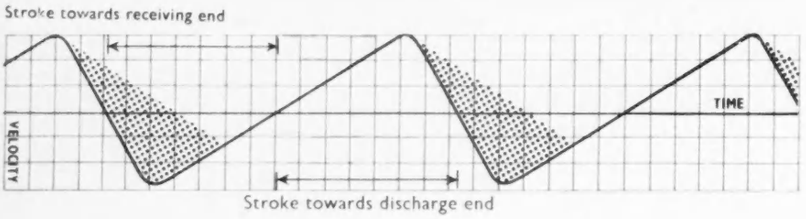


Shaker conveyor discharging scrap on to a similar conveyor.



Sand cores and risers from engine component castings fall on to a shaker conveyor which carries them to a rotary scrap breaker and sand separator.

Shaker conveyor showing type G 20 drive, driven by a 20 h.p. flywheel motor; this robust drive delivers high peaks of energy.



SHAKER CONVEYING

in a mechanised foundry

The Distington-Goodman shaker conveyor is not a jigger conveyor. Its troughs move in only one plane on ball-bearing rollers and propel material by variations in their rates of acceleration and deceleration (these are shown in the time-velocity curve above: the shaded areas represent the movement of material independent from the movement of the troughs).

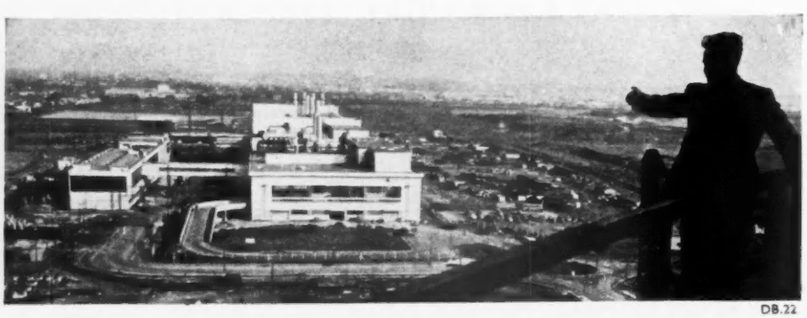
Distington-Goodman shaker conveyors have been used for many years for loading and conveying coal and rock. Their robust all-steel construction makes them ideal for handling hot materials in foundries and cement clinker and sinter.

They are easily extended and contracted and can be made self-loading from stock heaps. Lines of troughing can be made to deviate through angles up to 90°. Conveying capacity depends upon several factors but would normally exceed 60 t.p.h. on the level.

DISTINGTON ENGINEERING COMPANY LIMITED

WORKINGTON · CUMBERLAND · ENGLAND

DISTINGTON



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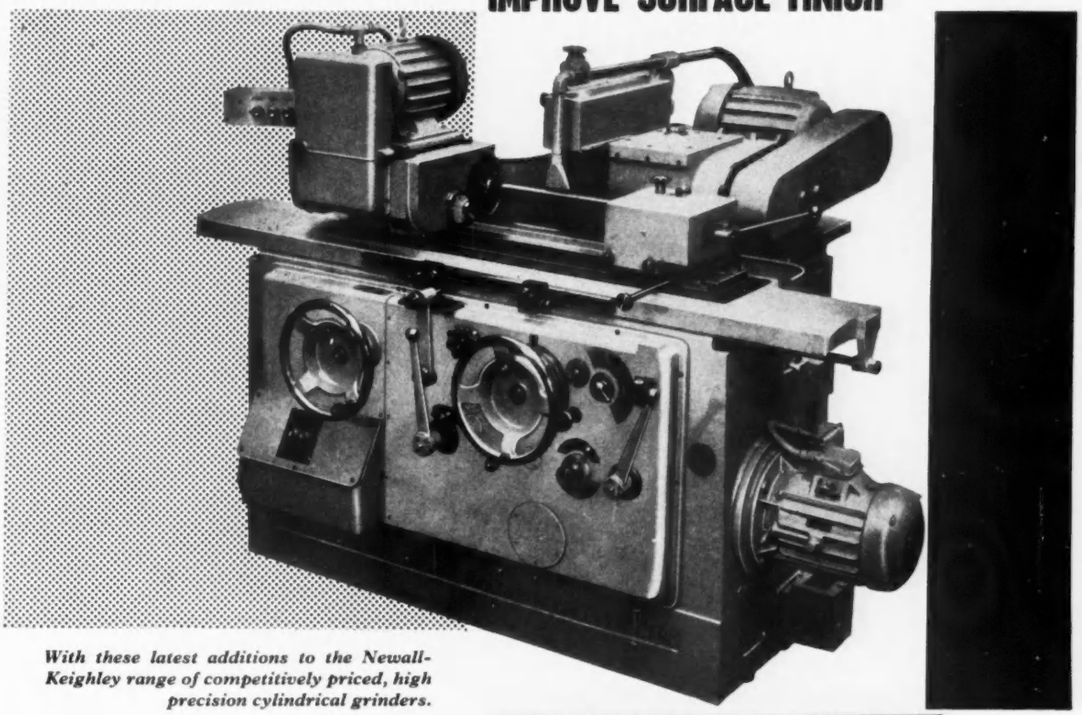
SAVE FLOOR SPACE
CUT PRODUCTION TIMES
IMPROVE SURFACE FINISH



With these latest additions to the Newall-Keighley range of competitively priced, high precision cylindrical grinders.

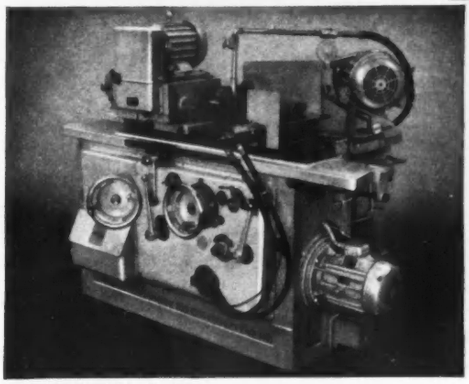
SERIES L4 AND L6

Features :—

* Capacity between centres—18 inches (18 or 24 inches in type L6), maximum grinding diameter—6 inches.
* Compactness—self-contained unit reduces space requirements to a minimum.
* Fully hydraulic operation of wheelhead and table movement.
* Unit construction of hydraulic control panel simplifies operation and aids servicing.
* Built to give toolroom tolerances and superior component finish under exacting production conditions.
* Hydraulic wheelhead—mounted dresser or internal grinding head included in wide range of optional equipment.

NEWALL-KEIGHLEY

For further details or machine demonstration apply to :



SERIES L6

Angle Head Grinder

This high production machine with 45° angle head for grinding an external diameter and adjacent face of a component from one setting has an extensive field of application in modern engineering practice. Built to the same sturdy proportions as the plain grinder illustrated above and with similar features, it is offered with a capacity of 18 inches or 24 inches between centres and will grind components up to 6 inches diameter.

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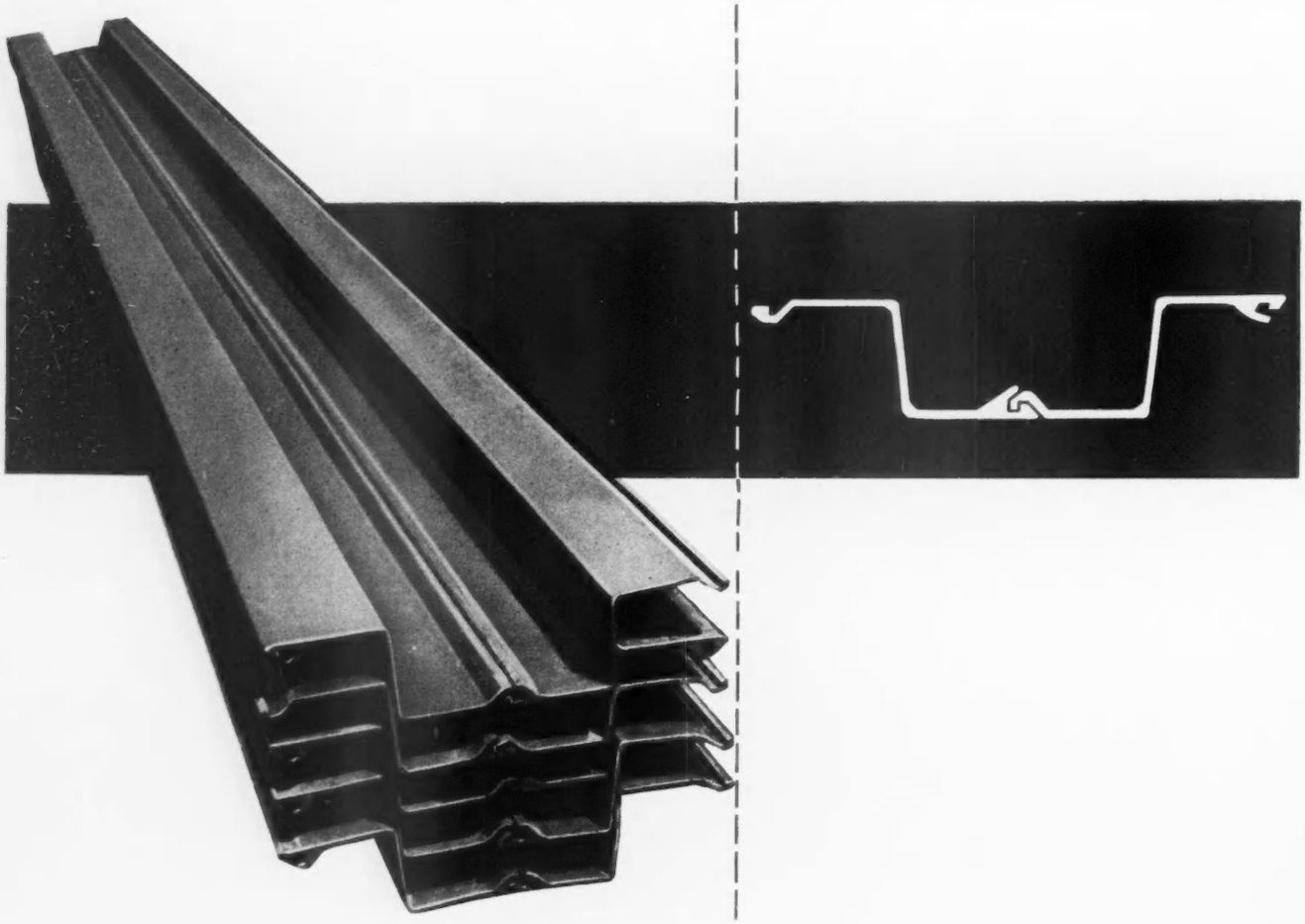

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In the range of dependable

Ruston-Bucyrus excavators

there is one which will serve your purpose best

In choosing a Ruston-Bucyrus excavator, irrespective of size or type, you will be sure of a machine that has been proved to give sustained high output at low cost combined with long life, even in the toughest work.

Examine the features of R-B machines which users and operators alike appreciate

Simple machinery layout for easy maintenance, adjustment and servicing.

Ball and roller bearings for smooth, efficient transmission of power.

Fast, easy-acting control to maintain high output.

Clutches and brakes of individual design and ample capacity for their duty.

Choice of mountings to achieve maximum stability for the specific operating conditions.

Easy conversion and equal efficiency with each front-end equipment.

When no less than twenty-four excavators of one make are engaged on a major airport project in rocky terrain involving 'against the clock' scheduling for completion of the work, there must be some significance in the make of machine selected. Among the two dozen or so R-B excavators working on the new Arlanda airport in Sweden is this 30-RB air-control machine with cambered-boom dragshovel equipment demonstrating its superior ability to excavate satisfactorily in the toughest materials.

RUSTON-BUCYRUS

There is an excavator to suit you in the R-B range-3/8 to 6 cubic yards capacity

Write now for information on the size of the machine in which you are interested.

Ruston-Bucyrus Limited

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Silicones for the engineer
1021
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MS
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MS

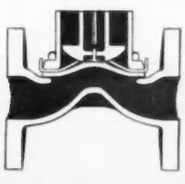
*Silastomer silicone rubber withstands temperature extremes

Because of their excellent temperature stability diaphragms of Silastomer silicone rubber are used in many of the various types of valves manufactured by Saunders Valve Co. Ltd. Silastomer will remain serviceable at temperatures as low as −70°C, where other rubbers harden and become brittle, and as high as +250°C, where organic rubbers char and decompose. Silastomer is also resistant to a wide range of chemicals.

Apart from their use as valve diaphragms Silastomer silicone rubbers have many applications as seals and gaskets which must remain durably resilient at elevated temperatures. Grades are available to resist petrol, lubricating and hydraulic oils. Silastomer is also used in paste form as a high temperature caulking and sealing compound and can be coated on to glasscloth for use as heat resistant sleeving, ducting and diaphragms.

The photograph shows one of the many types of Saunders Valves in use in industry. BY COURTESY OF SAUNDERS VALVE CO. LTD.

The sectional view shows the resilient diaphragm in the Saunders Valve. The excellent temperature stability of silicone rubber diaphragms enables these valves to be used for conveying gases and chemicals at extremes of temperature.



* SILASTOMER IS A REGISTERED TRADEMARK OF MIDLAND SILICONES LTD.

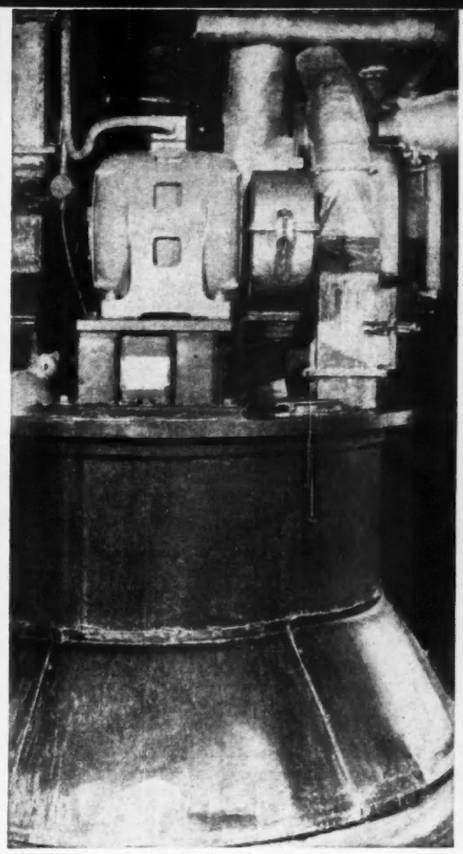


Photo by courtesy of Thomas Hedley Co. Ltd.

MS

Silicone motor rewind saves £400

Thomas Hedley & Co. Ltd., at the company's West Thurrock factory, found that one of their motors working in a particularly wet position, on a mixing tank used in the manufacture of synthetic detergents, broke down at average intervals of 6 months. Rewinds were tried in Class A insulation (costing £30 each time), and in Class B insulation with extra varnish dips to give additional protection against moisture – both without success. Finally they tried a silicone rewind. This was nearly seven years ago and the motor has been operating since without failure, thus saving approximately £400 in rewind costs. In addition losses in production time due to motor failure have been eliminated.

MS silicones strengthen the weak link in all forms of electrical equipment – its insulation. With silicone-insulated motors the risk of breakdown through insulation failure is very greatly reduced. Have your most troublesome motors rewound with silicone insulation. Write to Midland Silicones for names of rewinders with experience in using silicone insulation.

MS

Antifoam kills foam –boosts output

Kill foam and increase the productive capacity of machine tools with a highly efficient MS silicone defoamer. The water and oil coolants used in the heavy-duty grinders shown in the photograph foamed so badly that it was necessary to shut the machine down for 15 minutes of every hour just to clear foam away. Conventional foam inhibitors were partially effective, but reduced the efficiency of the coolant.

A silicone antifoam agent was added to the coolant and foam vanished immediately – "like a punctured balloon" – and hourly grinder output increased 25%.

MS silicone defoamers are effective in low concentrations making them most economical in use. They will remain stable for long periods in either hot or cold storage conditions.

There is an MS silicone antifoam agent in the form of a compound, fluid or emulsion to deal with your particular foaming problem.

First in British Silicones

Write for full information about these and the many other silicone products with applications in the engineering industry including release agents, damping and hydraulic fluids, heat-resistant paint, resins, lubricants and electrical insulants.

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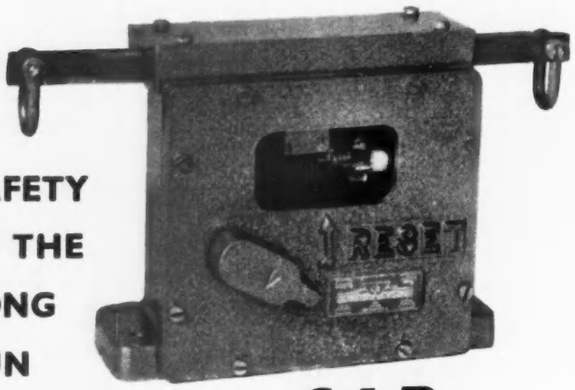

SAFETY IN THE LONG RUN WITH THE . . . C.J.R

MAGNETIC SAFETY TRIP WIRE SWITCH

Designed specially for use with conveyors and similar equipment, where long runs of machinery are in use, this C.J.R. safety device stops the driving motor (or applies a brake), at a touch of the trip wire. You owe it to yourself and your employees to fit this infallible safety device.

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MANUFACTURERS OF INDUSTRIAL ELECTRONIC EQUIPMENT AND LOW VOLTAGE SAFETY SYSTEMS

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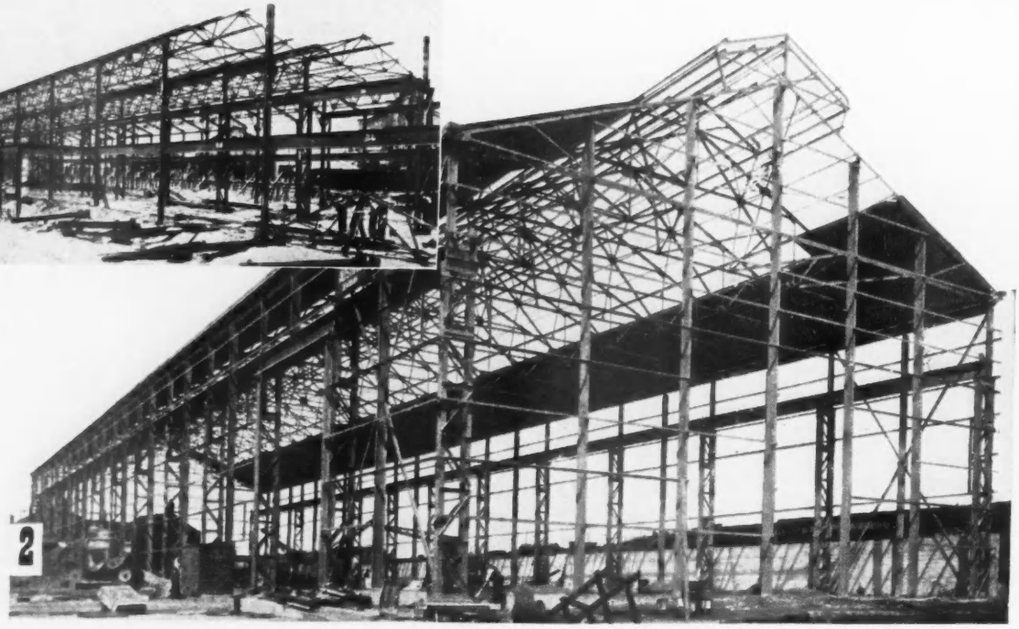
STRUCTURAL STEELWORK BY AUSTINS



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2 Fabrication Shops for prefabricating Ships for Messrs. Clelands Shipbuilding Co. Ltd., Wallsend-on-Tyne.

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graded for use with

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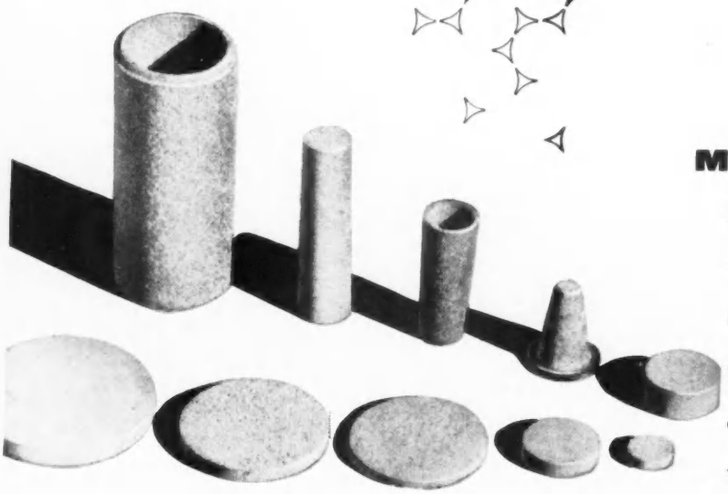
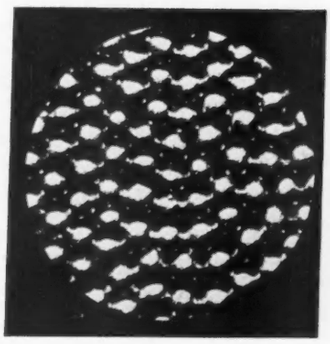


Many years' experience in powder metallurgy has resulted in the development by BOUND BROOK of a porous material for the filtering of liquids and gases. It is produced from spherical metal powders of *closely controlled particle size* to give a rigid porous bronze structure of *uniform pore dimensions*. This metallic structure has excellent resistance to impact, is suitable for high pressure filtration in both directions of flow, and enjoys an almost indefinite life. The material is easily cleaned either by washing or by reversing the flow. Designed for such applications as filter elements, flow control devices, flame traps etc., BOUND BROOK bronze filters are available in six grades to suit required conditions, and in the form of discs, plates, cones, hollow cylinders etc. Special shapes can be made to suit customers' requirements. For further information send for leaflet "BOUND BROOK Bronze Filters".



This photomicrograph shows a section of a Bound Brook filter. Note the porous structure formed by the use of spherical metal powder

A MEMBER OF THE BIRFIELD GROUP

Bound Brook Bearings Limited

Trent Valley Trading Estate, Lichfield, Staffordshire

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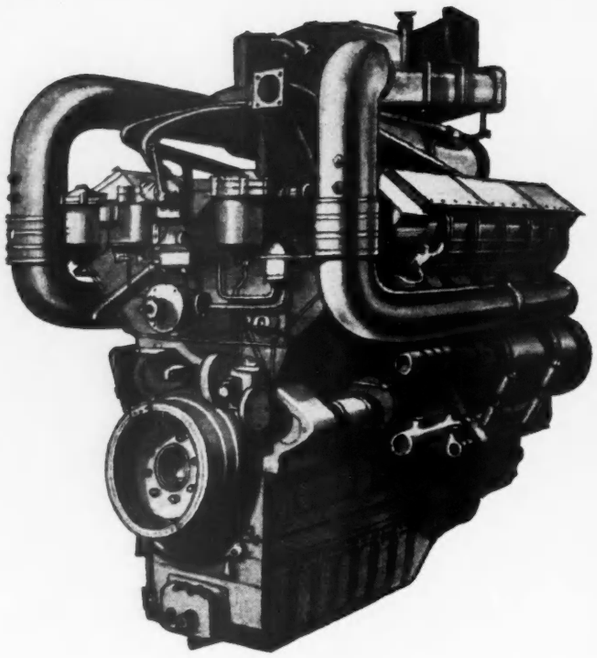
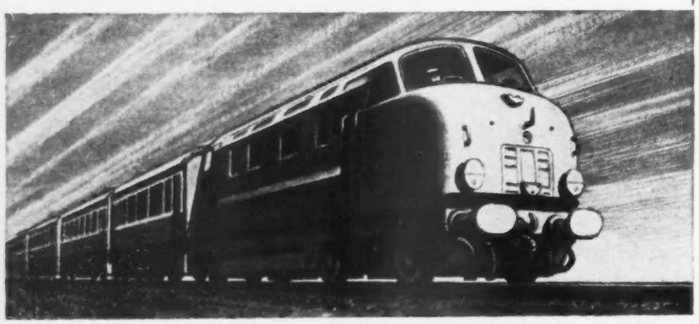


Typical of the MD range of engines is this Type 650 12 cylinder supercharged model with cylindersarrangedin'V'formation.



◀ Railway Traction 220-2,000 B.H.P.

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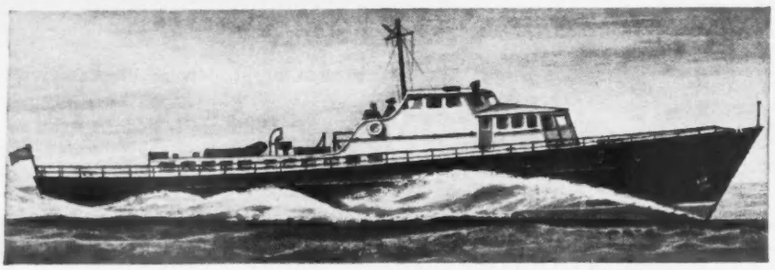

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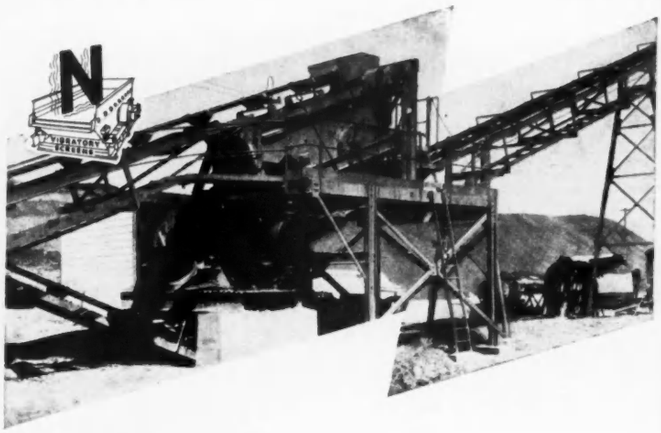

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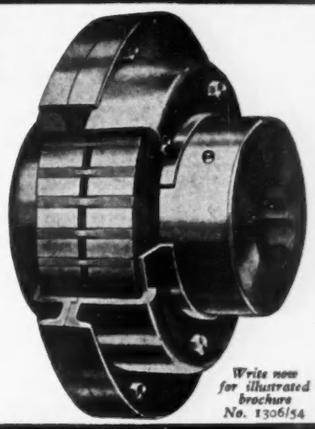

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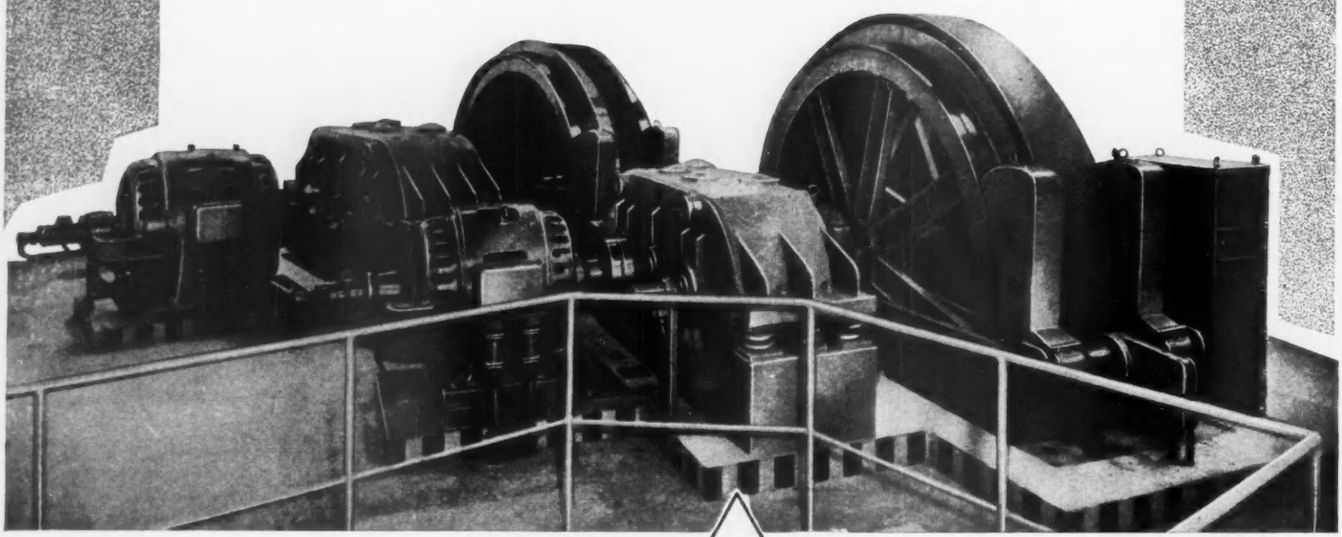

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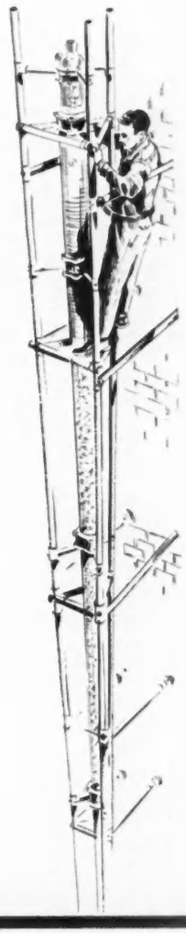

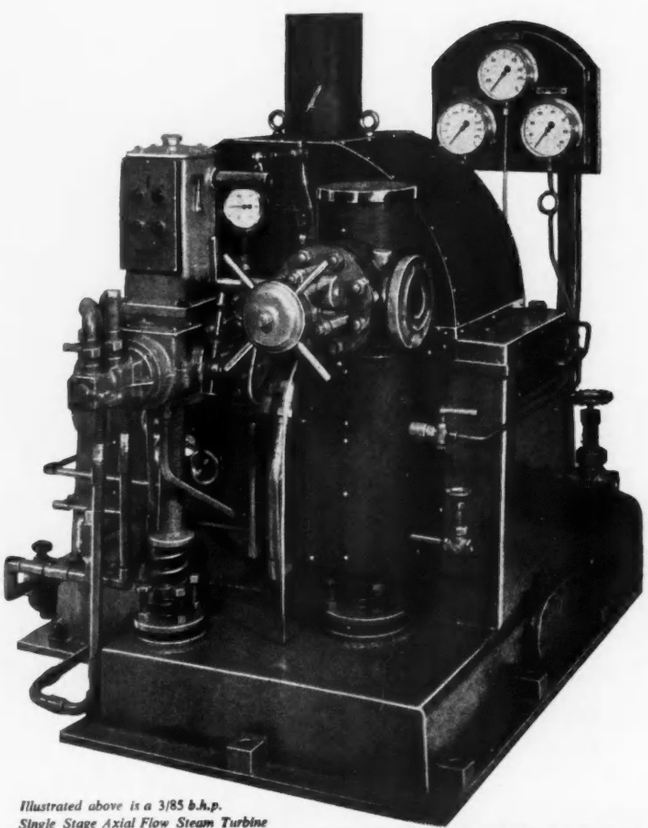

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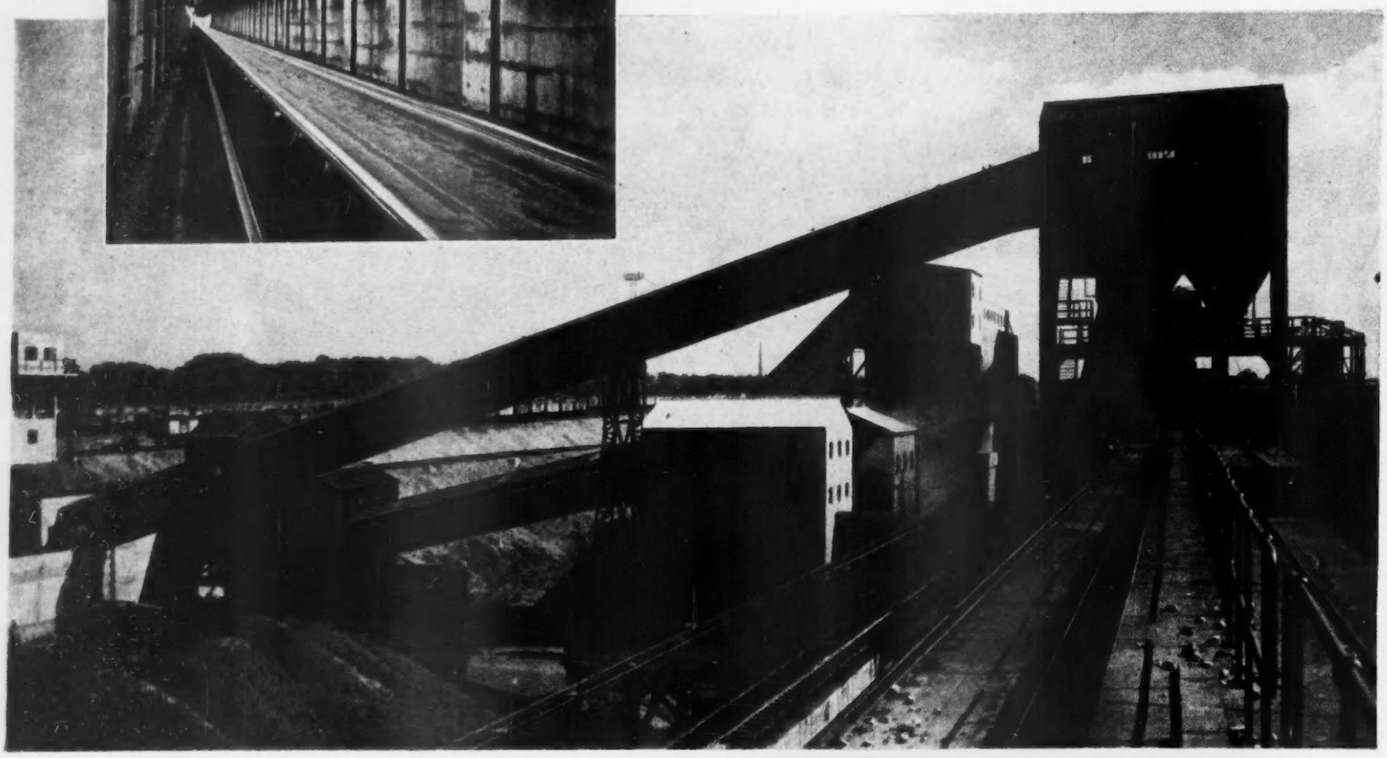

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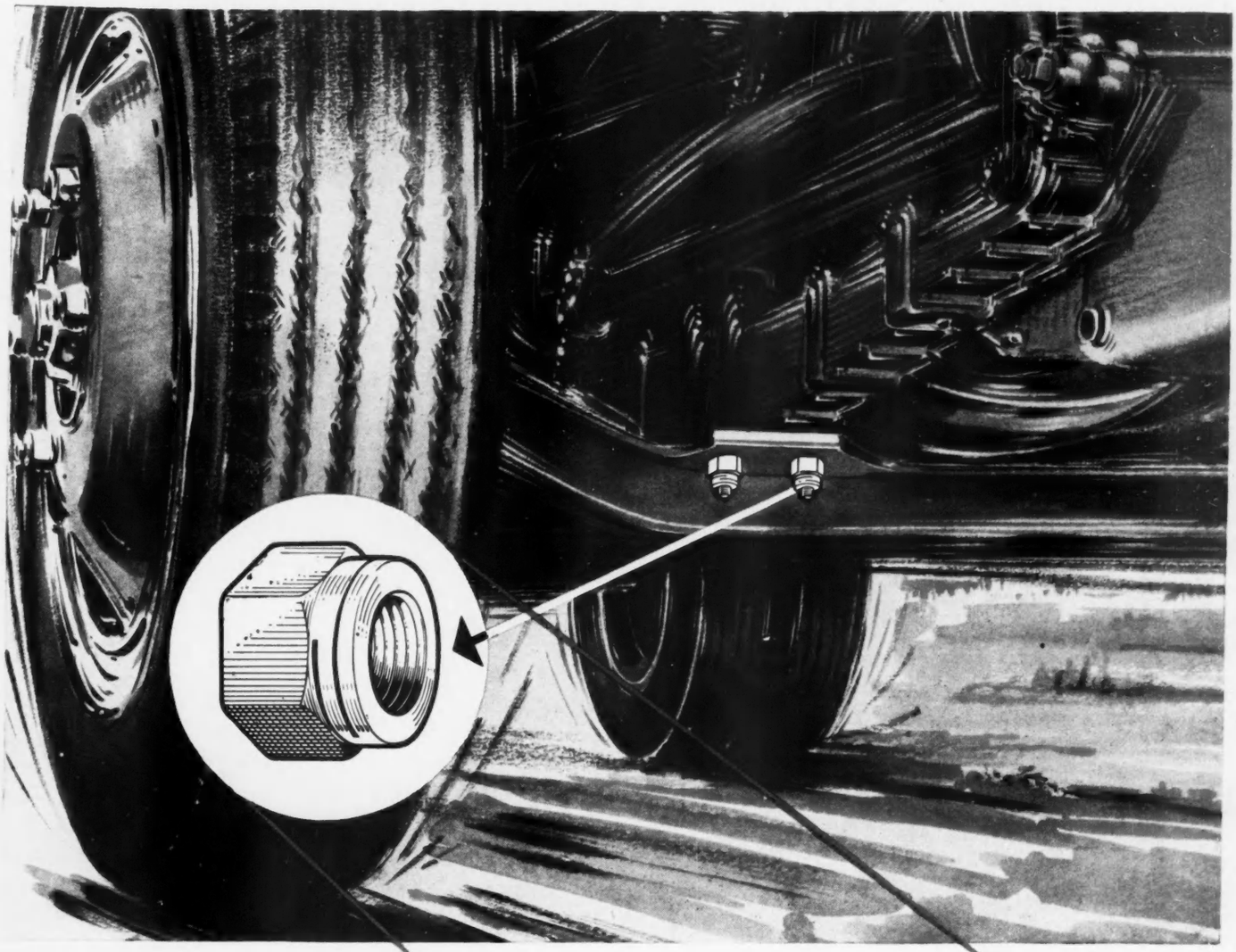

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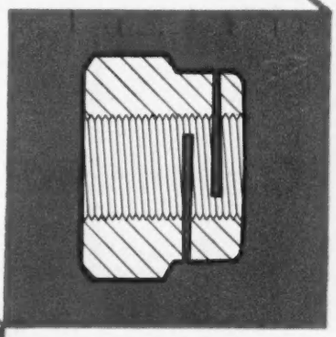

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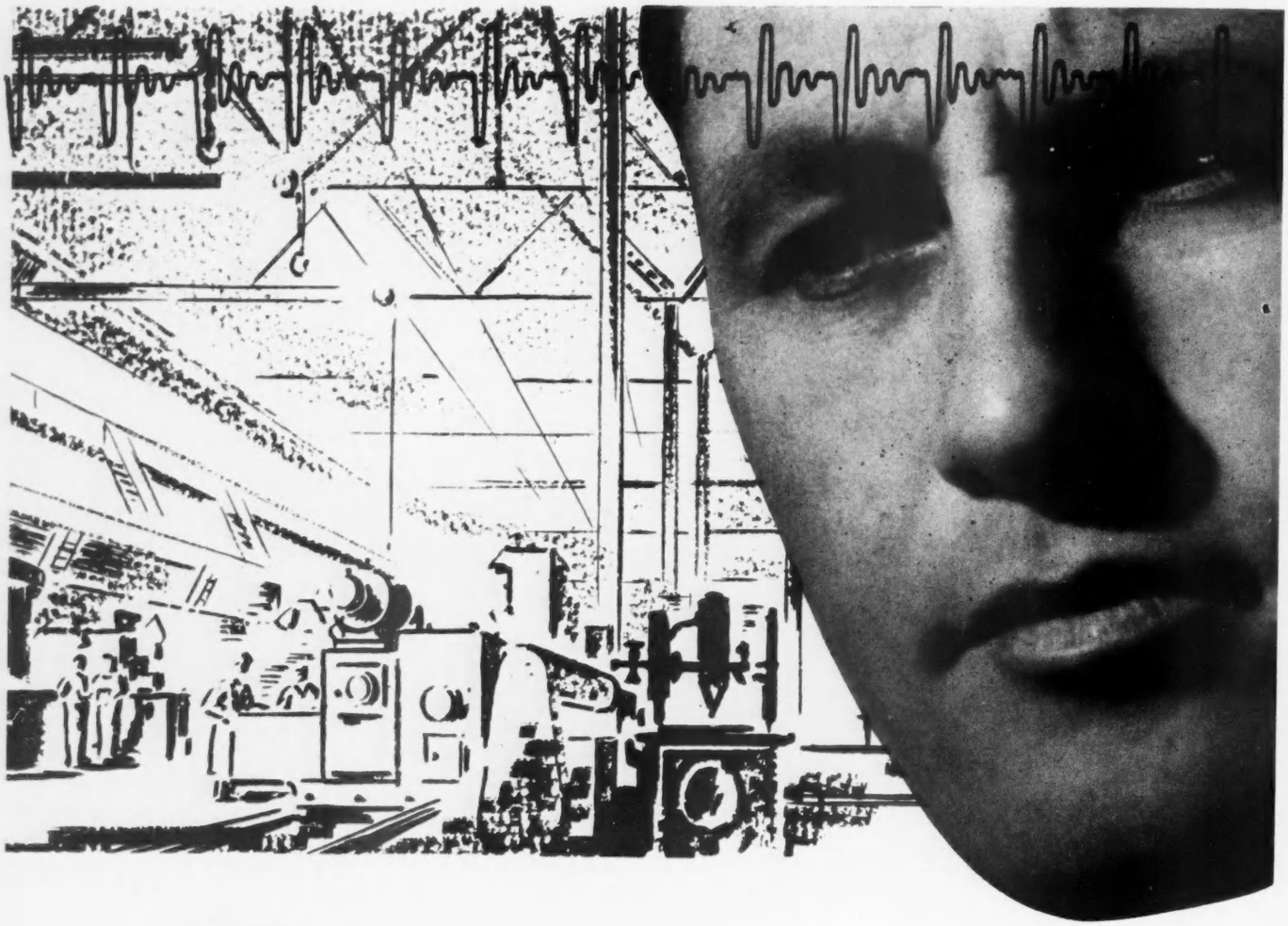

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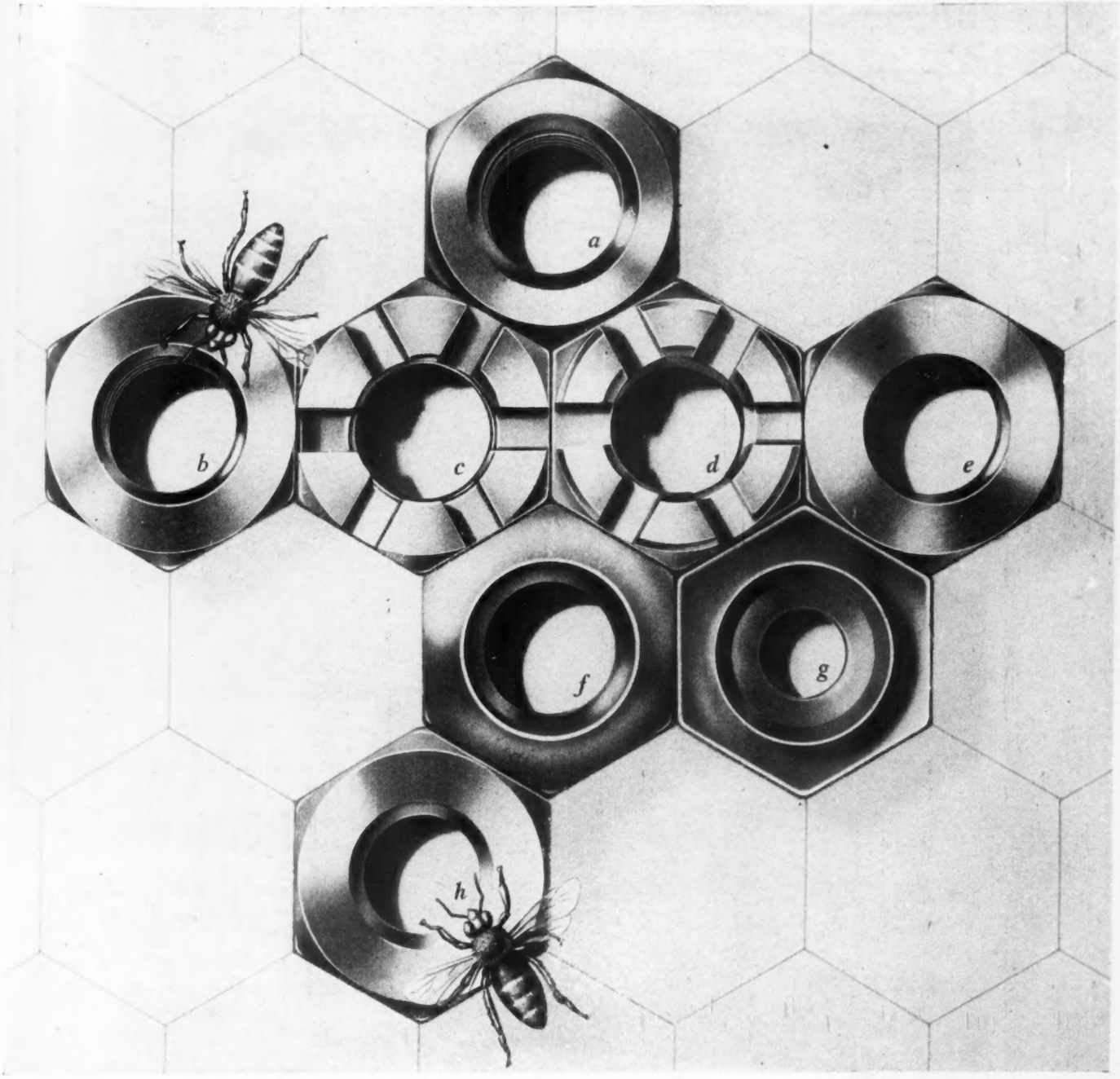

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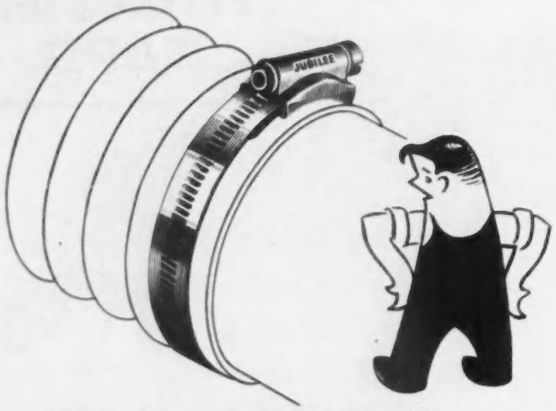

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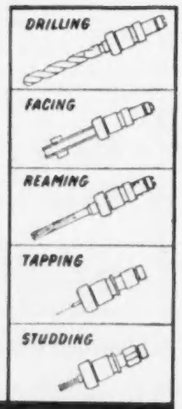

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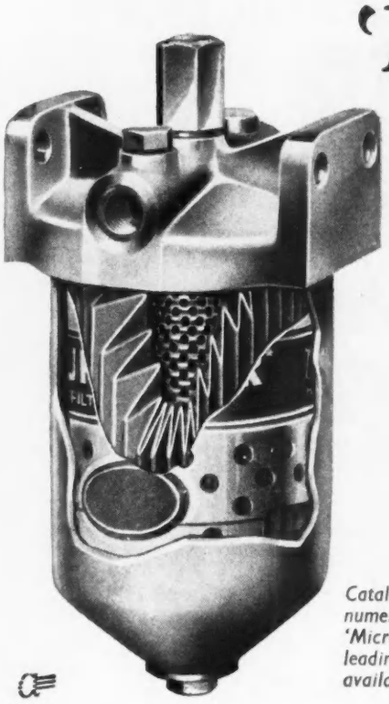

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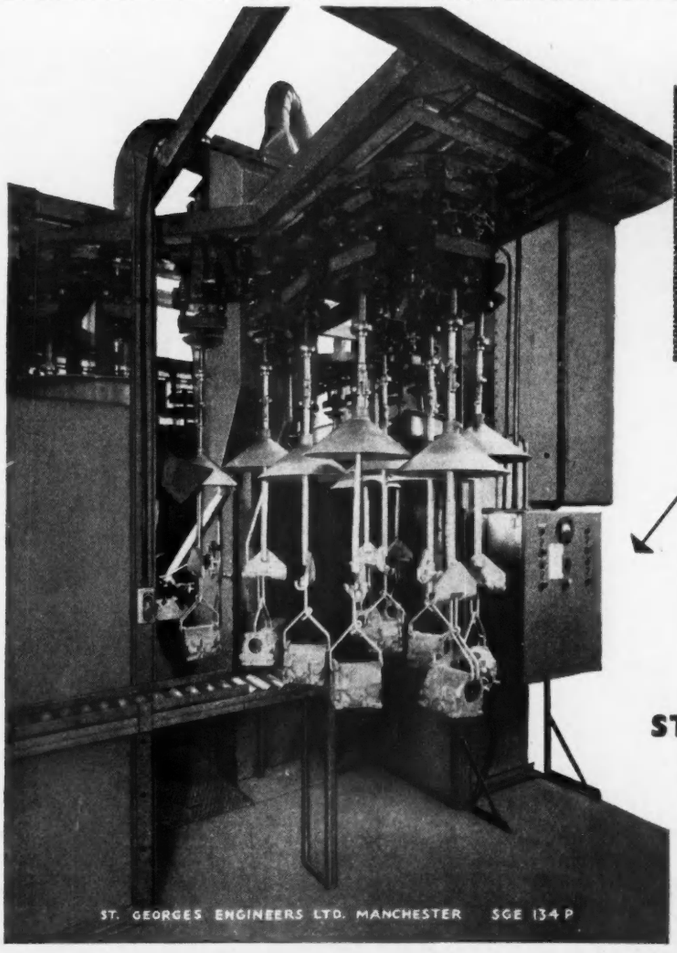

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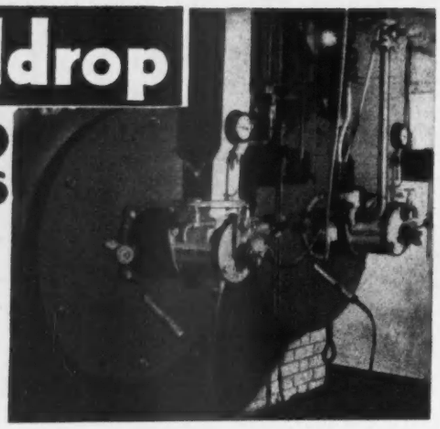

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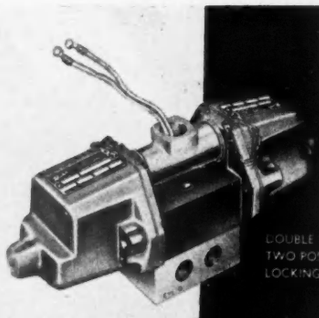

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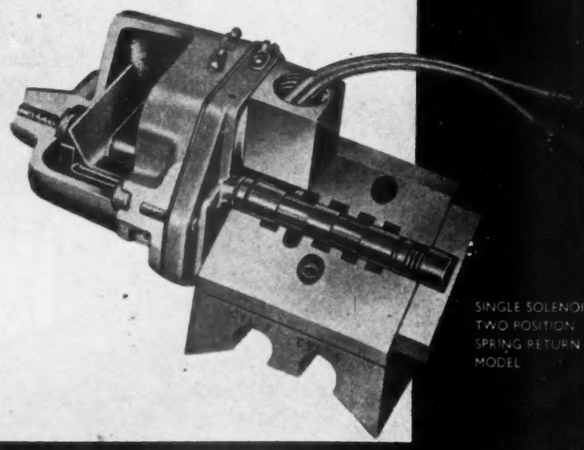

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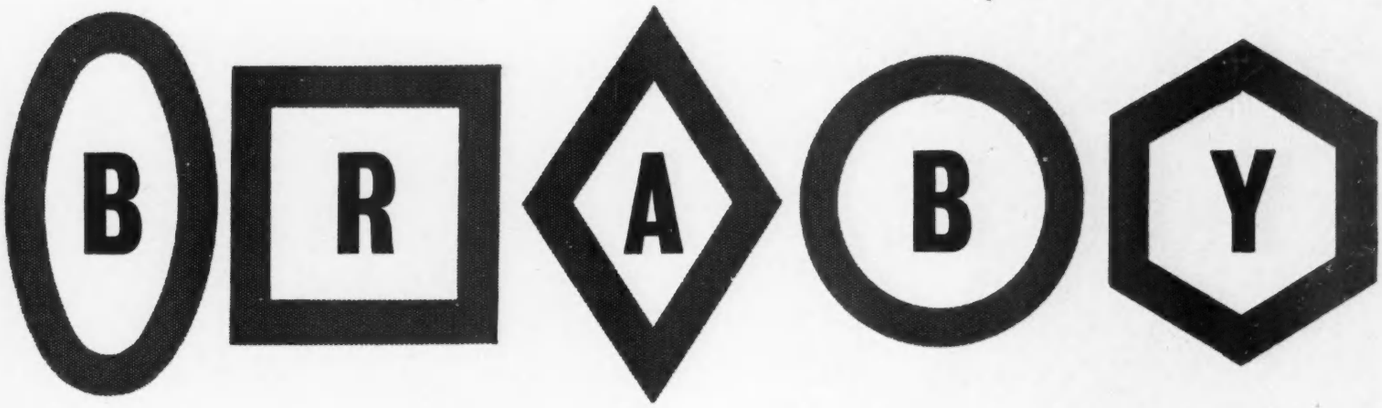

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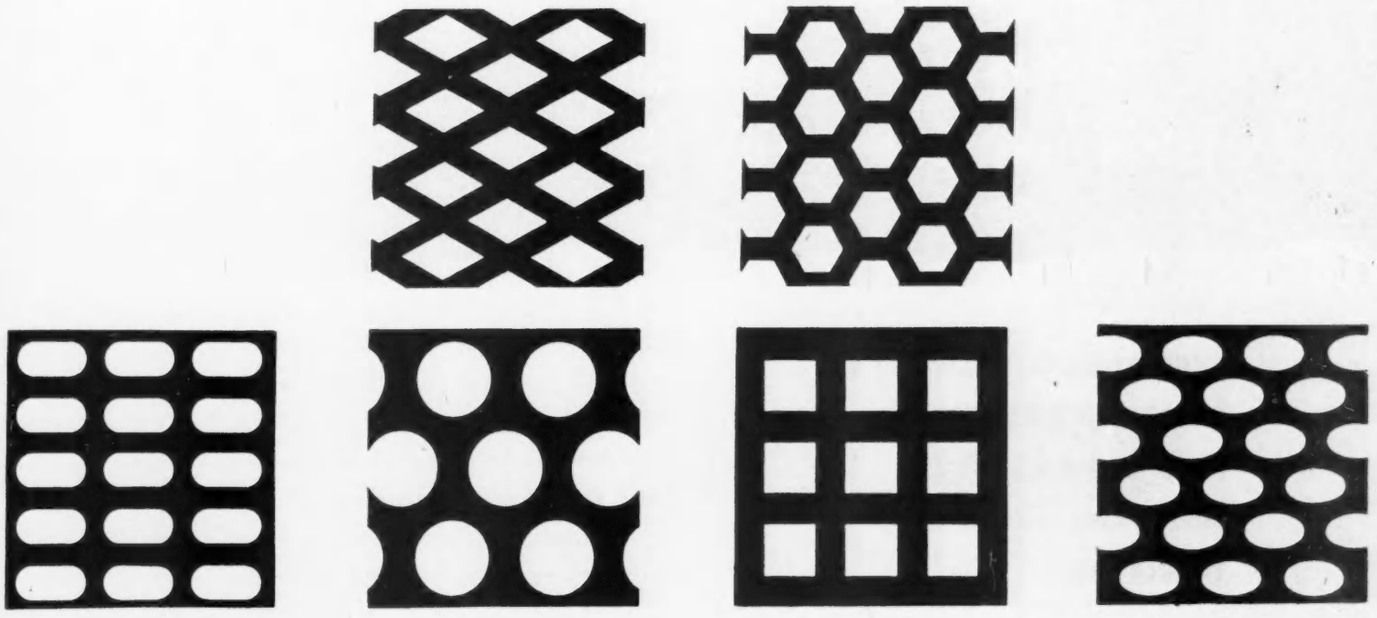

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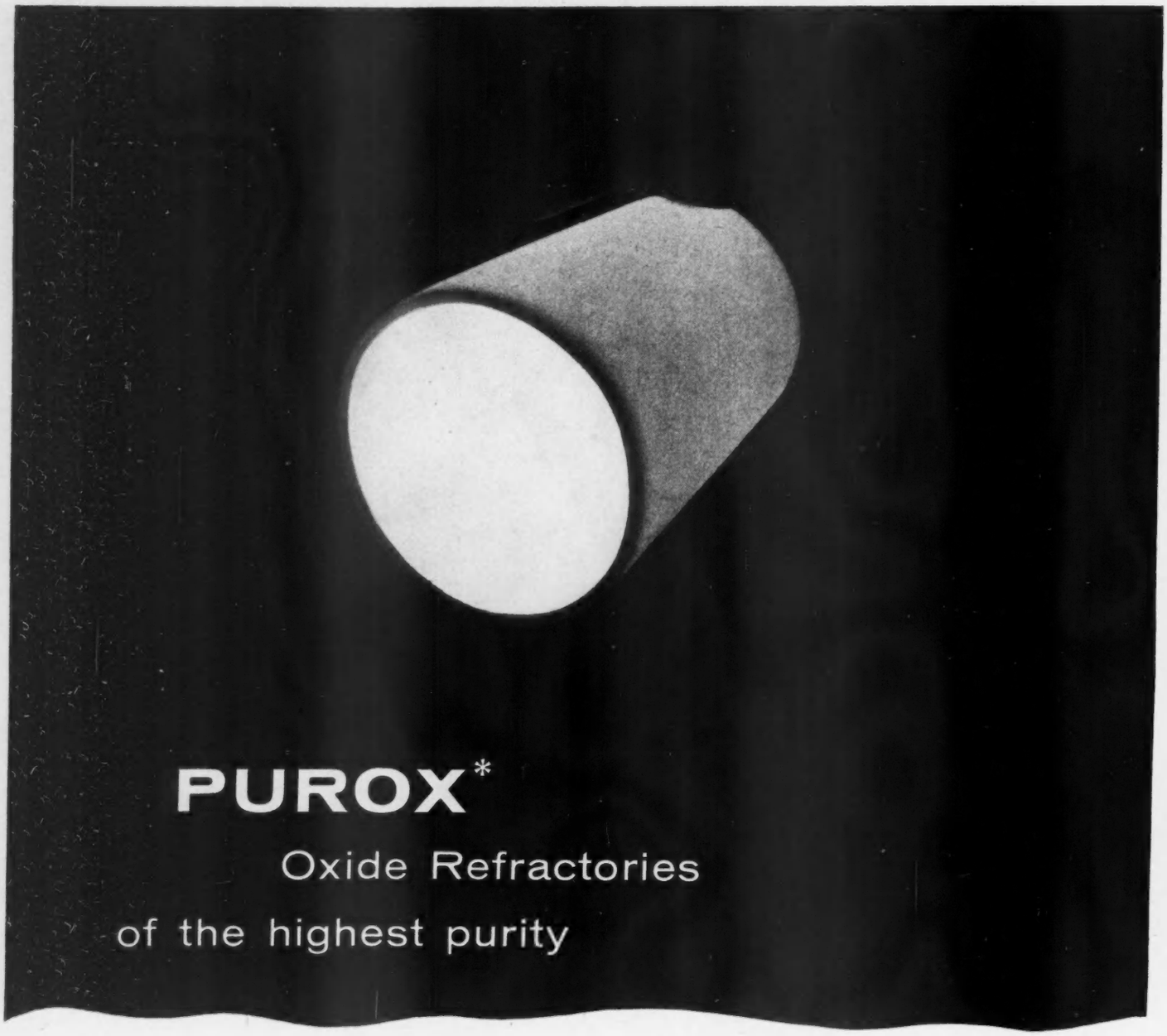

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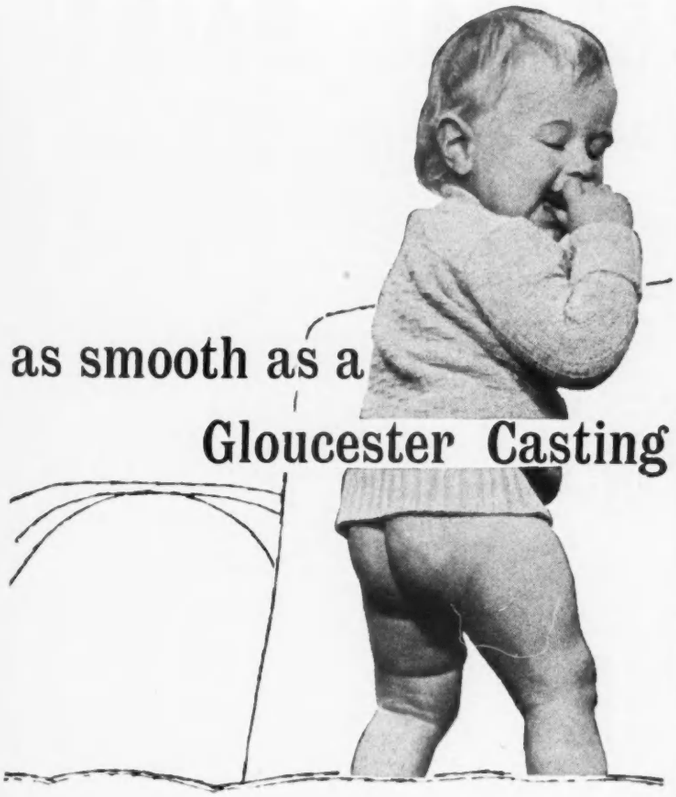
Recent development work at Neston has resulted in laboratory ware in these highly refractory materials becoming available to a greater degree of purity and in a wider range of shapes and sizes than has hitherto been possible.

These Pure Oxide refractories open up new possibilities in high temperature work, whether it is to be done in a laboratory or on an industrial scale.

MORGAN Refractories Ltd

MORGAN REFRACTORIES LIMITED, NESTON, WIRRAL, CHESHIRE. TEL: NESTON 1406 *Registered trade-name applied for. N.E 147/A



as smooth as a Gloucester Casting

The smoother and cleaner the casting the more accurately it fits into the machining jigs allowing saving of time during machining process. At Gloucester, Malleable iron castings are as clean as modern science and machines can make them.

Superb core making equipment, careful analysis of sand at every stage of the core making and moulding processes, the use of special mould and core dressings, ensure clean castings, even as they leave the "knock out" bay for final fettling.

The elevator type electric-furnace anneals in 48 hours instead of the usual 7 days. It also allows greater control of the casting during annealing, resulting in uniformity of metal, greater strength, and — a smoother, finer skin.

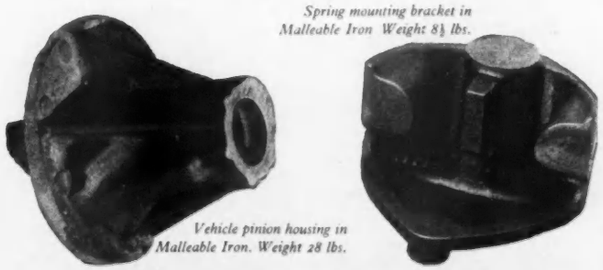
Gloucester can handle large runs of malleable and grey iron castings for the automobile, railway, electrical and farming industries.

Gloucester are always willing to visit customers and help in the design of castings to save time and cost in production.

A typical Gloucester Malleable specification.

Gloucester Blackheart Malleable	*Gloucester Lamellar Pearlitic Malleable*
Elongation .. 18%	Elongation .. 5%
Yield Point .. 12 tons	Yield Point .. 24 tons
Tensile Strength 25 tons psi	Tensile Strength 35 tons psi

Spring mounting bracket in Malleable Iron Weight 8¾ lbs.



Vehicle pinion housing in Malleable Iron. Weight 28 lbs.

GLOUCESTER

GLOUCESTER — THE HOME OF GOOD CASTINGS

Gloucester Foundry Ltd., Emlyn Works, Gloucester
phone : Gloucester 23041 grams : 'Pulleys' Gloucester
(A subsidiary of the Gloucester Railway Carriage & Wagon Co. Ltd.)

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MANUFACTURERS OF SPECIAL PURPOSE PRECISION MACHINERY INDIVIDUALLY DESIGNED TO SUIT CUSTOMERS' OWN PRODUCTION REQUIREMENTS

- ★ Rotary and Straight Line Transfer Machines for Multiple Machining operations.
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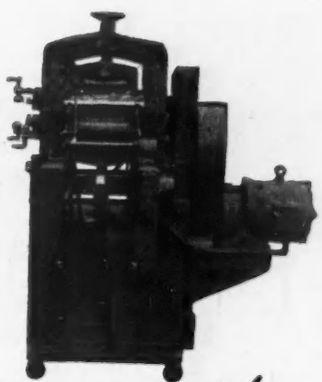
- ★ Rubber Manipulating machines.
- ★ Automatic Screw Driver Units.
- ★ Automatic Bar Turning machines.

WE OFFER A MACHINE DESIGN AND/OR MANUFACTURING SERVICE WITH LONG EXPERIENCE IN AUTOMATIC MACHINE BUILDING



Talk it over with

DATIM

Our advisory service can also assist in adapting existing machinery for special purposes, and security is an essential feature of our services—customers can present us with their problems in ABSOLUTE CONFIDENCE.

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Billet Road, Walthamstow, E.17
Telephone: Larkswood 2313 (3 lines)

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M

NINE ELMS INDUSTRIAL PAINTS

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INDUSTRIAL PAINTS DIVISION
17 ROCHESTER ROW
WESTMINSTER, S.W.1
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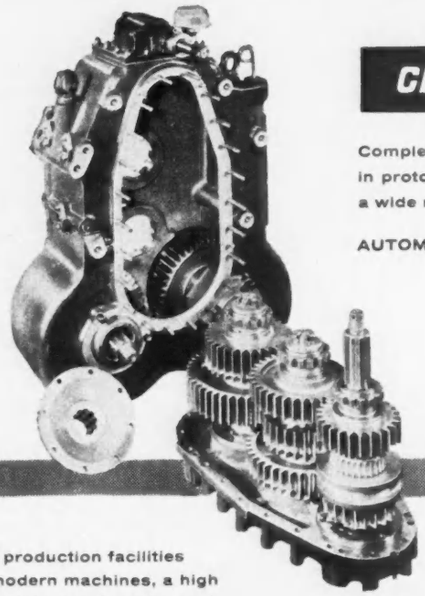
manufacturers of complete gear boxes

...to your design or specification, or designed by us to your requirements.

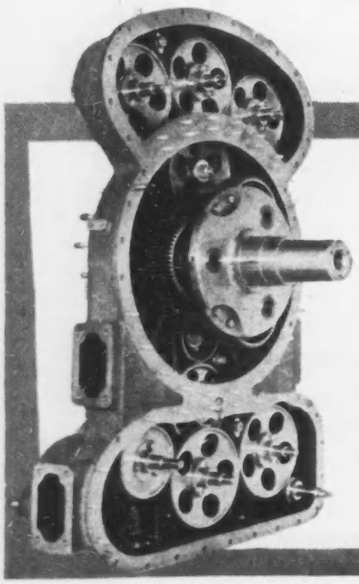


CENTRAX

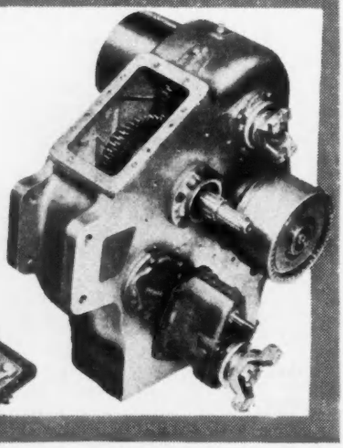
Complete gear boxes can be produced in prototype or production quantities for a wide range of industries, including:—

AUTOMOTIVE
AIRCRAFT
NUCLEAR
AUTOMATION
MACHINE TOOLS
GENERAL ENGINEERING
& EARTH MOVING

With acknowledgements to All Wheel Drive Ltd., Camberley, Surrey.



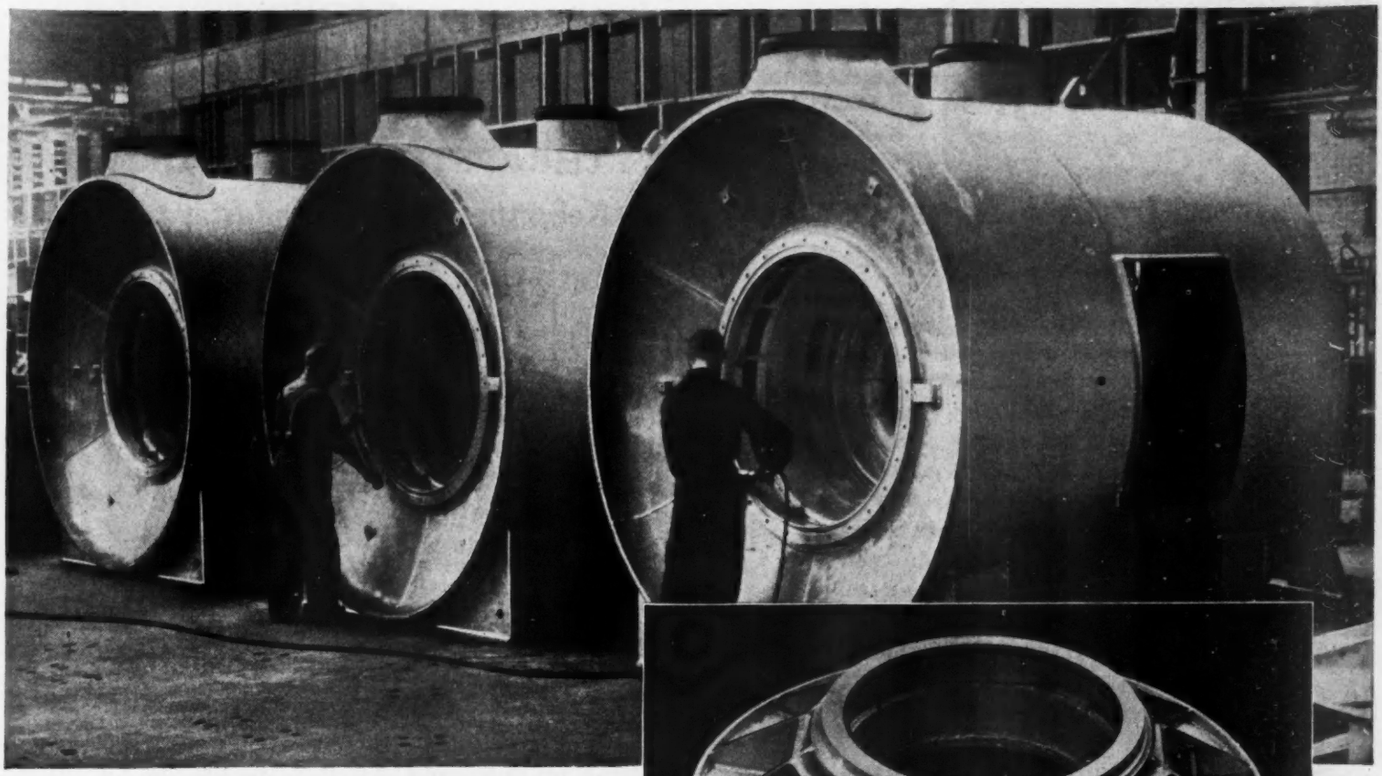
The latest production facilities are available—modern machines, a high standard of precision engineering and expert attention to all classes of work.



PRECISION GEARS & COMPLETE GEAR BOXES

CENTRAX

CENTRAX LIMITED · NEWTON ABBOT · DEVON
Telephone: NEWTON ABBOT 2251-5



Some of the many hundreds of welded aluminium fabrications built by Fairey for the United Kingdom Atomic Energy Authority. Each of the three examples at the top weighs 4½ tons ; the other weighs 18 cwt. and has a diameter of 8 ft. 5 in.

FAIREY PRESSURE VESSELS AND STRUCTURES IN STEEL AND ALUMINIUM

Fairey Engineering Ltd. offer a Fabrications facility equal to any in the world.

Pressure Vessels including refinery and chemical vessels, heat-exchangers, and large-diameter pipe, as well as many special types.

Structures such as bridge sections, roof trusses, crane jibs and oil derricks.

The Fairey Group of Companies provide a full Metallurgical Service, both in plant and at site, including X-Ray, vacuum and ultra-sonic testing; standards met include A.I.D., A.R.B. and U.K.A.E.A. and Lloyds Class 1.

For vessels or structures . . . in steel or aluminium . . . talk to Fairey first

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LIMITED

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DISHED AND FLANGED DRUM ENDS.
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SINGLE FLANGED NOZZLES.
DOUBLE FLANGED STANDPIPES.
PIPE LINE FITTINGS INCLUDING BENDS, TEES, CROSSES, REDUCERS, CAPS, SADDLES AND SLEEVES.
PIPE LINE FLANGES, SLIP-ON WELDING NECK AND BLANK.
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London Office :—

10, NORFOLK STREET, LONDON, W.C.2

Telegrams : TUBENPIPE, PHONE, LONDON

Telephone : COVENT GARDEN 6315/6/7

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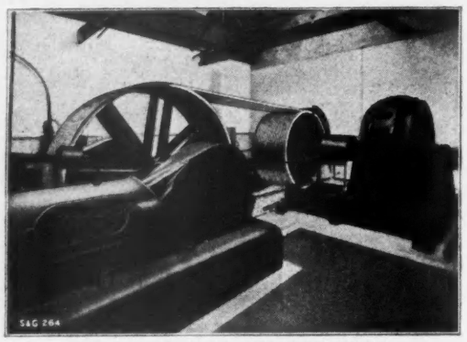
THRAPSTON V ROPE DRIVES

Keep the wheels of industry turning



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FLEXIBLE · EFFICIENT · RELIABLE
ECONOMICAL · SILENT · CLEAN

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Makers of Power Transmission Appliances for over a Century

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Inspection

At first sight this may have seemed to be a good weld ; but chief engineers make certain by employing Welding Supervision.

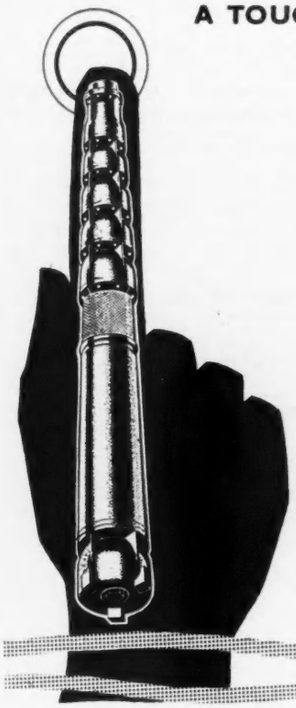
Only experience and integrity can confirm your second thoughts.

WELDING SUPERVISION LIMITED

CJB HOUSE, EASTBOURNE TERRACE, PADDINGTON, LONDON, W.2.

Telephone : AMBASSADOR 8080. Cables : CIVANIC, LONDON

A TOUCH OF THE BUTTON



and up comes the water

It's common sense to put the pump where the water is—down the well or borehole. But once it's down there it has to be utterly reliable, so it must be a Beresford submersible pump, rust-proof, self-lubricating, durable. You'll find your Beresford cheap to install, efficient in operation and there's a model designed to raise ample water for your needs, whatever they are. May we send you full details?

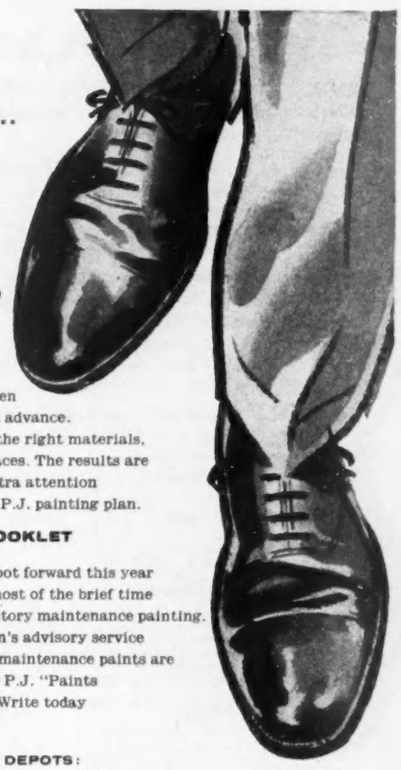
BN. 254

BERESFORD | *submersible pumps*

JAMES BERESFORD & SON LTD · KITTS GREEN · BIRMINGHAM 33.

THE CORNERCROFT GROUP OF COMPANIES. TEL.: STEchford 3081

WHEN IT COMES TO MAINTENANCE PAINTING...



are you putting your best foot FORWARD?

The difference between routine repainting and P.J. *planned* factory maintenance is the difference between defensive operations and a very real advance. The plan is no more than selecting the right materials, texture and colours for the right places. The results are out of all proportion to the little extra attention demanded by the consideration of a P.J. painting plan.

PAINTS FOR BUILDINGS BOOKLET

Put your best foot forward this year and make the most of the brief time available for factory maintenance painting. Pinchin Johnson's advisory service and specialised maintenance paints are described in the P.J. "Paints for Buildings". Write today for your copy.

LOCAL BRANCHES AND STOCK DEPOTS:

BELFAST: Dalton Buildings, Dalton St.	Belfast	58643
BIRMINGHAM, 1: King Edward's Place, Broad Street	Midland	1042-3-4
BOOTLE, 20: 72 Brewster Street	Liverpool, Bootle	2121
BRIGHTON, 1: 26-27 Elder Place	Brighton	23739
BRISTOL, 8: 21 High Street, Clifton	Bristol	33889
GLASGOW, C.2: Ocean Chambers, 190 West George Street	Douglas	3281-2
LEEDS, 11: 123 Water Lane	Leeds	24377
MANCHESTER, 3: 22 Bridge Street	Blackfriars	3900
NEWCASTLE-ON-TYNE, 1: Pudding Chare	Newcastle-on-Tyne	21919
SOUTHAMPTON: 41 Lower Canal Walk	Southampton	23648

PINCHIN JOHNSON & CO.

(Building Paints Division) Dept. TE1, 4 CARLTON GARDENS, LONDON S.W.1. Telephone: TRAfalgar 5600

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USE YOUR KNOWLEDGE IN A WORTHWHILE JOB

VACANCIES FOR

BOILER MAKERS
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(STORE HANDLING EQUIPMENT)
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MILLWRIGHTS
FITTERS (PLANT)
PLUMBERS & PIPE FITTERS
SAW DOCTORS
WELDERS

in

THE ROYAL ENGINEERS
(FIELD)

Up to £25 tax-free Bonus plus first-rate wages for two weeks of your time

ARE you in a skilled trade? Then you can probably add a tidy sum to your income by joining the Army Emergency Reserve. For one thing, you get pay and allowances at full Regular Army rates whilst in camp. And the more your skill is worth in civilian life, the higher your Army trade pay will be. Better still, you also get £9-£25 bonus tax-free.

For this you just spend 14 days a year at a camp, working on your own speciality. And money's not the only profit you get from that. You get a grand refresher course, giving you a lot of new ideas, and putting you right in touch with the latest Army developments. And you get a welcome break from the usual routine, with sports, games and a great social life. For the place is full of people with the same interests as yourself. Don't miss this chance! Send off the coupon now to: H.Q., A.E.R., R.E. (Field & Works), Harper Barracks, Ripon, Yorks.

POST THIS OFF RIGHT AWAY!

Please send me—without obligation—the illustrated booklet telling all about the Army Emergency Reserve.

NAME _____

ADDRESS _____

_____

TRADE _____ (JU/AER)

CLASSIFIED ADVERTISEMENTS

AGENCIES · DIRECTORS · PARTNERSHIPS · SITUATIONS VACANT · EDUCATIONAL PATENTS · BUSINESS OPPORTUNITIES · MISCELLANEOUS · PUBLIC APPOINTMENTS BUSINESSES and PREMISES · TENDERS

Lineage Rate. 4/- per line of approximately 6 words. Minimum 16/-.

Inch Rate. 48/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g., ¼-page £25 10s. ½-page £48. Full page £90.

AUCTION SALES · FOR HIRE · MACHINERY, etc., WANTED · SITUATIONS WANTED DRAWING AND DESIGN SERVICES · FOR SALE · SUB-CONTRACTING

Lineage Rate. 3/6 per line of approximately 6 words. Minimum 14/-.

Inch Rate. 42/- per single column inch and *pro rata*. 12 lines to 1 inch. There are reduced rates (*i.e.*, not on a *pro rata* basis) for advertisements of ¼-page (12 column inches) and upwards, e.g. ¼-page £22, ½-page £41 10s. Full page £78.

Series Discounts. For advertisements 1 inch and upwards. 6 insertions 5%. 13 insertions 10%. 26 insertions 15%.

Run-On and Semi-Displayed Styles. Both these styles are available for single column width advertisements of any depth up to 12 inches.

Displayed and Illustrated Styles. The minimum size for a Displayed advertisement is 3 inches single column, for an illustrated advertisement it is a ¼-page (12 column inches). Thereafter the sizes for both progress in steps 3 inches deep across 1, 2, 3 or 4 columns.

Use of Box Number. 2/- which includes forwarding of replies.

Copy Dates. "Run-on" and "Semi-displayed" advertisements by noon Tuesday for publication on Friday same week. "Displayed" and "Illustrated" advertisements by noon Friday for publication on following Friday. All advertisements three days earlier if proofs are required.

Advertisements for publication should be addressed to—**Classified Advertisement Dept., "The Engineer", 28 Essex Street, Strand, London, W.C.2.**

Urgent advertisements may be telephoned to CENtral 6565

PUBLIC APPOINTMENTS

COLOMBO PLAN

UNIVERSITY OF CEYLON

TWO APPOINTMENTS

Applications are invited by the Commonwealth Relations Office for two appointments under the Technical Co-operation Scheme of the Colombo Plan, at the University of Ceylon, as follows :—

1. PROFESSOR OF MECHANICAL ENGINEERING.
2. LECTURER IN ELECTRICAL ENGINEERING (EECTRIC POWER).

Candidates for both posts must have several years' research and University teaching experience. Duration three years in the case of the Professor of Mechanical Engineering and two to three years in the case of the other post.

Salary (subject to United Kingdom income tax) for (1) £2600 per annum, plus tax-free oversea allowance of £1175 per annum (married) or £675 per annum (single), and for (2) £1850 per annum, plus tax-free oversea allowance of £1175 per annum (married) or £675 per annum (single), plus other allowances. Free furnished accommodation provided. Contract with the United Kingdom Government.

For further information and application forms, write Ministry of Labour and National Service (E.9), 26–28, King Street, London, S.W.1, quoting E.9/TCS/216-7/CEY. E6034

FOURAH BAY COLLEGE,

SIERRA LEON

(UNIVERSITY OF DURHAM)

APPOINTMENTS

Applications are invited for posts of (A) SENIOR LECTURER TO BE HEAD OF DEPARTMENT OF ENGINEERING ; (B) LECTURER IN ELECTRICAL ENGINEERING. Salary scales : (A) £1700 by £75 to £2150 p.a., with a non-pensionable Head of Department allowance of £150 p.a. (B) £965 by £50 to £1415 by £75 to £1790 p.a. Entry point according to qualifications and experience. F.S.S.U. Outfit and family allowances. Passages for appointee and family on appointment, annual leave and normal termination. Part furnished accommodation at rent not exceeding 7½ per cent of salary.

Detailed applications (6 copies) naming 3 referees by 7 July, 1959, to Secretary, Inter-University Council for Higher Education Overseas, 29, Woburn Square, London, W.C.1, from whom further particulars may be obtained. E6022

BEDFORDSHIRE EDUCATION COMMITTEE

MANDER COLLEGE, BEDFORD

SENIOR LECTURER

Applications invited for the following appointment at Mander College, Bedford, as from 1st September, or as soon as possible thereafter.

SENIOR LECTURER in MECHANICAL ENGINEERING. Honours graduate for O.N.C. and H.N.C. classes in Strength of Materials, Theory of Machines, Theory of Structures.

Salary scale : £1417 10s. to £1627 10s.

Forms of application and further particulars from the College Principal.

T. C. LUCKING,
Director of Education.
E6028

LONDON COUNTY COUNCIL

WANDSWORTH TECHNICAL COLLEGE

ASSISTANT GRADE "B"

Wandsworth Technical College require, September 1959, ASSISTANT, Grade "B," in Mathematics, to teach up to H.N.C. standard ; should be Graduate in Mathematics ; knowledge of statistics an advantage. Burnham F.E. salary scale, £682 10s. by £26 5s. to £1076 5s., plus London allowance and additions for training and qualifications. Increments within the scale for experience.

Application forms from the Secretary at the College, Wandsworth High Street, S.W.18, returnable by 24th June, 1959. (1290) E6043

PUBLIC APPOINTMENTS

PEEL PARK TECHNICAL COLLEGE, SALFORD

Principal : F. WOOD, M.A. (Oxon.), LL.B., A.I.B., A.M.B.I.M., F.R.S.A.

APPOINTMENT OF SENIOR LECTURER IN INDUSTRIAL DESIGN

RE-ADVERTISEMENT

Applications are invited from suitably qualified candidates for the post of SENIOR LECTURER, to be responsible for courses in Aesthetics and Industrial Design to day-release and evening classes for engineers, and the development of this subject, in the School of Art and Industrial Design.

Industrial experience is essential, and consideration will be given to the successful applicant maintaining contacts with industry.

Salary in accordance with the Burnham Technical Scale for Senior Lecturers : Men, £1417 10s. by £52 10s. to £1627 10s.

Application forms and further particulars may be obtained from The Principal, Peel Park Technical College, Salford, 5, to whom completed forms should be returned as soon as possible.

R. RIBBLESDALE THORNTON,
E6067 Clerk to the Governors.

THURROCK TECHNICAL COLLEGE

WOODVIEW, GRAYS, ESSEX

ASSISTANT TEACHER GRADE "B"

Required, for 1st September, 1959 :

ASSISTANT TEACHER GRADE "B" in Mechanical Engineering, required to teach Thermodynamics to Higher National Certificate standard. Applicants should have Graduate qualifications or equivalent, industrial experience, and some teaching experience. Post includes responsibility for the Thermodynamics and Heat Engines Laboratory and the teaching of allied subjects at a lower level.

Salary in accordance with Burnham Scale, 1956, plus 5 per cent. addition.

£682 10s. by £26 5s. to £1076 5s.,

plus additions for approved qualifications and training.

Application forms from the Principal. Closing date 30th June. E6068

NORTHAMPTON COLLEGE OF ADVANCED TECHNOLOGY, ST. JOHN STREET, LONDON, E.C.1

RESEARCH ASSISTANTSHIPS

Applications are invited from Graduates and Prospective Graduates in Engineering or Metallurgy for research projects as follows :—

(a) Work hardening of steel bars. Salary £500 p.a.

(b) Other projects on properties and fatigue of metals and on fluid mechanics. Basic salary £300 p.a.

Additional payments of £100 p.a. or more for assistance in tutorial or laboratory classes. Research Assistants are expected to work for a higher Degree of the University of London.

Forms of application available from the Head of the Civil and Mechanical Engineering Department. E6072

UNIVERSITY OF LIVERPOOL

DEPARTMENT OF FLUID MECHANICS

ASSISTANT LECTURER OR LECTURER

Applications are invited for the post of ASSISTANT LECTURER or LECTURER in the Department of Fluid Mechanics. The initial salary will be within the range £700–£1250 per annum, according to age, qualifications and experience. Candidates should have an Honours Degree, and experience in hydraulics would be an advantage.

Applications, stating age, academic qualifications and experience, together with the names of three referees, should be received not later than 6 July, 1959, by the Registrar, from whom further particulars of the conditions of appointments may be obtained. E6069

PUBLIC APPOINTMENTS

WOOLWICH POLYTECHNIC, LONDON, S.E.18

SENIOR LECTURER

Applications invited for SENIOR LECTURER in Electrical Engineering ; should have high academic qualifications and industrial experience and an interest in power and machines ; opportunities for research.

The work is largely concerned with electrical subjects of the B.Sc.(Eng.) degree of London University (General Internal) and Dip.Tech. in Electrical Engineering.

Salary scale £1350 by £50 to £1550, plus 5 per cent., with London Allowance of £36 to £48, plus 5 per cent.

Particulars and application form from Clerk to Governors, to be returned by 27th June, 1959. E6020

UNIVERSITY OF SHEFFIELD

LECTURER IN MECHANICAL ENGINEERING

Applications are invited for a post of LECTURER in MECHANICAL ENGINEERING to begin duties on 1st October, 1959. Initial salary according to qualifications and experience on the scale £900 by £50 to £1350 by £75 to £1650, with F.S.S.U. provision and family allowance. A grant towards removal expenses will be made. Further particulars may be obtained from the Registrar to whom applications (4 copies) should be sent by 27th June, 1959. E6024

CALDERSTONES HOSPITAL MANAGEMENT COMMITTEE

CALDERSTONES HOSPITAL, WHALLEY, NR. BLACKBURN

ASSISTANT ENGINEER

Applications are invited for the post of ASSISTANT ENGINEER at the above hospital (2378 beds). Applicants must have completed an apprenticeship in mechanical engineering, or have otherwise acquired a sound, practical training in mechanical engineering, and must also have practical experience in engineering maintenance in charge of craftsmen and operatives.

Qualifications required : one of the following or equivalent approved by the Ministry of Health :

Ministry of Transport and Civil Aviation Second Class Certificate of Competency in Marine Engineering.

Ministry of Transport and Civil Aviation Certificate of Service as Second Class Engineer.

Ordinary National Certificate in Mechanical Engineering, which includes Heat Engines as a subject, and is endorsed in the Principles of Electricity.

Ordinary National Certificate in Electrical Engineering with endorsement in Applied Mechanics and Heat Engines.

The successful applicant will be responsible for assisting the Committee's Superintendent Engineer in the supervision of engineering services at the hospital over the whole range of his duties.

Salary scale : £640 by £20 (1) by £25 (2) by £30 (2) to £770 per annum.

Whitley Council Conditions of Service.

Modern house available for rent.

Appointment subject to medical examination.

Application forms obtainable from the Group Secretary, to be returned not later than 9 a.m. on Monday, 6th July, 1959. E6059

MINISTRY OF SUPPLY

CHESSINGTON, SURREY

TECHNICIANS

Ministry of Supply require TECHNICIANS at Chessington, Surrey, to work on preparation of technical publications on airborne and ground electrical equipment.

Qualifications : Recognised engineering apprenticeship or equivalent training in appropriate trade. Sound knowledge electrics essential. H.N.C. or equivalent qualifications and experience in writing or editing technical publications advantageous.

Rate of Pay : £1065–£1300 per annum.

Forms from M.L.N.S. Technical and Scientific Register (K), 26, King Street, S.W.1, quoting D.278/9A. Closing date, 13th July, 1959. E6035

PUBLIC APPOINTMENTS

CENTRAL ELECTRICITY GENERATING BOARD

SOUTHERN PROJECT GROUP

ASSISTANT ENGINEERS

Applications are invited for the following appointments at Nuclear Power Stations now under construction by the Group.

BRADWELL (Essex) and BERKELEY (Gloucestershire).

THIRD ASSISTANT ENGINEERS (Mechanical). Ref. S/59/19.

FOURTH ASSISTANT ENGINEERS (Mechanical). Ref. S/59/20.

The successful candidates will be required to assist the Site Mechanical Engineers in the supervision of the installation and testing of mechanical engineering plant, covering both conventional and nuclear plant. Experience in the supervision of construction of major engineering works and in the installation of conventional boiler and turbine plants, would be an advantage.

The salaries for the appointments will be in accordance with Schedule C of the N.J.B. Agreement, as follows :—

Third Assistant Engineers, Grade 5, £1090 to £1300 per annum.

Fourth Assistant Engineers, Grade 6, £850 to £1025 per annum.

Applicants should have some works experience or apprenticeship training and have qualifications up to the Higher National Certificate or equivalent standard.

The successful candidates would be expected to live in the vicinity of the site for the duration of the construction work which will be approximately an eighteen months-two year period. Opportunities will be available for transfer to future power station sites and to design teams associated with these stations.

Applications, stating age, qualifications, experience, present position and salary, and indicating the post for which application is made, should be forwarded to the Administrative Officer, Central Electricity Generating Board, Southern Project Group, Squires Lane, Finchley, London, N.3, to arrive not later than 26th June, 1959.

Envelopes should be marked "Confidential," with the appropriate reference.

T. YULE,
E6056 Chief Project Engineer.

TRINIDAD AND TOBAGO ELECTRICITY COMMISSION

VACANCIES FOR TWO SHIFT CHARGE ENGINEERS

Owing to vacancies caused by promotion, the Trinidad and Tobago Electricity Commission has vacancies for TWO SHIFT CHARGE ENGINEERS.

Applicants should have experience in the operation of modern steam turbines, water-tube boilers and diesel generators, and must have Graduate Membership of the I.E.E., or I.Mech.E., or Associate Membership of the I.Mar.E., or the Higher National Certificate in Electrical or Mechanical Engineering or Second Engineer's M.O.T. Diesel and Steam Certificate or Charge Certificate, Royal Navy.

The annual salary is £1408, rising by three annual increments to £1537. This salary includes a payment for shift work. As new plant is being commissioned at the Penal Generating Station the salary of the Charge Engineer appointed to that station will be increased during 1960 to £1580, rising to £1710.

A partly furnished house will be provided at a rent of £10 8s. 4d. per month plus a small extra charge for heavy furniture.

An outfit allowance of £60 is paid on arrival in Trinidad.

First-class passage to Trinidad will be provided for the successful applicant, his wife and children, up to a maximum cost of four adult passages. First-class leave passages to the United Kingdom will be provided every three years.

There is a superannuation scheme similar to the C.E.A. and Area Boards' scheme.

Information on Trinidad can be obtained from the West India Committee, 40, Norfolk Street, London, W.C.2.

Applications, giving full details of qualifications, age, experience, &c., together with copies of two recent testimonials, should be sent by Air Mail to reach the General Manager, Trinidad and Tobago Electricity Commission, P.O. Box 121, Port-of-Spain, Trinidad, W.I. by 31st July, 1959. E6076

PUBLIC APPOINTMENTS

ROYAL NAVAL SCIENTIFIC SERVICE

SENIOR SCIENTIFIC OFFICERS AND SCIENTIFIC OFFICERS

Vacancies for SENIOR SCIENTIFIC OFFICERS and SCIENTIFIC OFFICERS in following localities:
LONDON AREA: MECHANICAL ENGINEER with sound knowledge of basic principles of thermo and fluid dynamics, to carry out research programme in a particular field of applied hydrodynamics. Experience in modern methods of design and research on axial flow compressors, turbines or pumps an advantage. MECHANICAL ENGINEER for work on propulsion problems. APPLIED MATHEMATICIAN for research of basic nature on stability of underwater vehicles: knowledge of theoretical hydrodynamics and theory of control systems an advantage. APPLIED MATHEMATICIAN or THEORETICAL PHYSICISTS for acoustic analysis. ELECTRONIC PHYSICISTS for data handling and analysis problems. PHYSICIST interested in operator performance. CLASSICAL PHYSICISTS.
BALDOCK: PHYSICISTS or APPLIED MATHEMATICIANS for research in Metal or Quantum Physics.
PORTSMOUTH: ELECTRONIC ENGINEERS for research on analogue computers and transistor circuits. ELECTRICAL ENGINEERS for research on small rotating electrical machinery. PHYSICISTS—for optical systems and instrumentation. ELECTRO-MECHANICAL ENGINEERS — for work on servo-mechanisms.
PORTLAND: PHYSICISTS or APPLIED MATHEMATICIANS for research on underwater acoustics. ELECTRONIC PHYSICISTS, ELECTRONIC ENGINEERS—for design work. PHYSICAL CHEMISTS.
POOLE: CHEMICAL ENGINEERS. CHEMISTS for work on rubber technology.
ROSYTH: PHYSICISTS (Electronic).
Candidates must normally be natural born British subjects of natural born British parents, with First or Second-Class Hons. Degrees. S.S.O.s must have had three years' post-graduate experience and be not less than 26 years of age. Salaries: (men) S.S.O., £1233–£1460; S.O., £655–£1150 (London), somewhat lower in provinces. Appointments unestablished (with F.S.S.U. benefits), but opportunities may occur for those between ages of 21 and 32 to compete for established posts.
Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1 (quote A.220/9A). E5866

EAST AFRICAN INDUSTRIAL RESEARCH ORGANISATION

AGRICULTURAL RESEARCH ENGINEER

AGRICULTURAL RESEARCH ENGINEER required to undertake the scientific investigation of the mechanical drying and storage of crops, especially coffee.
Temporary appointment on Research Branch, Overseas Service terms, as Senior Scientific Officer or Principal Scientific Officer for three years in first instance.
Salary range: £1284–£2241. Gratuity 13⅓ per cent of salary. Free passages. Quarters provided at moderate rent. Generous leave.
Candidates, between 32 and 40 years, must possess B.Sc. (Engineering), Honours, or be A.M.I.E.E., preferably with post-graduate training. He should have had post-graduate training and research experience in agricultural engineering, with particular reference to drying and storage of crops.
Write, Director of Recruitment, Colonial Office, London, S.W.1, stating age, qualifications and experience, quoting BCD 195/463/04. E6037

LEEDS (GROUP B) HOSPITAL MANAGEMENT COMMITTEE

MEANWOOD PARK HOSPITAL TONGUE LANE, LEEDS, 6

SENIOR ENGINEER

Applications invited from suitably qualified persons for the resident post of SENIOR ENGINEER for the Engineering Services (Mechanical and Electrical) at the above Mental Deficiency Hospital of 800 beds, vacant 1st October, 1959. Previous hospital experience desirable. Whitley Council conditions and salary on the points scale 10½/20 viz: £680 per annum by annual increments to £815 per annum. House available on rental. Application forms (returnable by 30th June) and further particulars of qualifications, &c., required, can be obtained from the Group Secretary, Seacroft Hospital Leeds, 14. E6084

THURROCK URBAN DISTRICT COUNCIL

ENGINEER AND SURVEYOR'S DEPARTMENT

ENGINEERING ASSISTANT

Thurrock Urban District Council (Engineer and Surveyor's Department) require ENGINEERING ASSISTANT. Salary within A.P.T. I/II: £610–£880 per annum. Candidates should have completed their training in a Municipal or Civil Engineer's Office and have had some subsequent experience. Appointment pensionable.
Applications, stating age, qualifications and experience, and quoting three referees, to Clerk of the Council, Council Offices, Grays, Essex, by 23rd June, 1959. Canvassing disqualifies. Relationship with Members or Senior Officers of the Council must be disclosed. E6016

PUBLIC APPOINTMENTS

DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

NATIONAL ENGINEERING LABORATORY EAST KILBRIDE, NR. GLASGOW

EXPERIMENTAL OFFICER AS TECHNICAL WRITER

D.S.I.R., National Engineering Laboratory, East Kilbride, Nr. Glasgow, requires EXPERIMENTAL OFFICER as TECHNICAL WRITER to help keep industry informed of results of scientific research. Ability to express himself clearly essential and broad engineering background desirable.
Qualifications: Pass Degree, H.N.C., preferably in Mechanical Engineering, or equivalent generally expected. Age at least 26. Salary: £954–£1166. Housing available at East Kilbride for married staff.
Forms from M.L.N.S., Technical and Scientific Register (K), 26, King Street, London, S.W.1, quoting C.176/9A. Closing date, 10th July, 1959. E6036

THE ROYAL COLLEGE
OF
SCIENCE AND TECHNOLOGY
GLASGOW
(Affiliated to the University of Glasgow)

DEPARTMENT OF MECHANICAL, CIVIL AND CHEMICAL ENGINEERING

LECTURER AND ASSISTANT LECTURER

Applications are invited for above posts in Applied Mechanics Section from graduates with good Honours Degree and with experience, if possible, in servomechanisms and automatic control.
The courses are conducted on a sandwich system with the summer term free for research, opportunities for which are exceptionally good. Staff are encouraged to carry out research leading to a Higher Degree.
Salary on scale: Lecturer, £900–£1650; Assistant Lecturer, £700–£850, with superannuation and family allowance benefits.
Form of application may be obtained from the Secretary. E6062

ALL SAINTS HOSPITAL, BIRMINGHAM, 18

Applications are invited for the position of

SUPERINTENDENT ENGINEER

to this hospital group which consists of the main hospital and three ancillary units.
Applicants must have passed an examination in engineering technology and hold one of the following qualifications or an equivalent qualification approved by the Minister:
Ministry of Transport and Civil Aviation (ex Board of Trade) First class certificate of Competency in Marine Engineering. Ministry of Transport and Civil Aviation Certificate of Service as First Class Engineer.
City and Guilds full technological Certificate in Plant Engineering (First Class).
Salary: £890 by £25 (2) by £30 (1) by £35 (1) by £40 (1) to £1045.
This appointment is subject to medical examination. Applications together with names and addresses of three referees to be endorsed "Superintendent Engineer" and sent to the GROUP SECRETARY immediately. E6006

TENDERS

WATFORD RURAL DISTRICT COUNCIL

SEWERAGE—TOMS LANE AND BEDMOND, ABBOTS LANGLEY

TENDERS are invited for the CONSTRUCTION of approximately 2180 linear yards of 6 inch S.G.W. SEWER and 1730 linear yards of 9 inch S.G.W. SEWER in Toms Lane and part of the village of Bedmond, Abbots Langley, and 420 linear yards of 15 inch dia. CONCRETE SEWER in Station Road (adjoining Toms Lane), with 55 brick Manholes.
General conditions of contract, specification, bills of quantities and drawings may be obtained from the Council's Consulting Engineers, Messrs. J. D. and D. M. Watson, MM.I.C.E., 67, Tufton Street, Westminster, S.W.1, on or after Friday, 19th June, 1959, on payment of five guineas deposit, refundable only to contractors who submit bona fide Tenders and/or return all documents and drawings on or before the last day for receipt of Tenders. Cheques should be made payable to Watford Rural District Council.
The Council does not bind itself to accept the lowest or any Tender.
Tenders must be enclosed in the envelopes provided, endorsed "Tender for Sewerage—Toms Lane and Bedmond," and delivered to the undersigned by noon on Friday, 17th July, 1959.

S. A. NICHOLSON,
Clerk to the Council.
Wynyard House,
Langley Road,
Watford, Herts. E6014

TENDERS

INDIA SUPPLY MISSION

The Office of the India Supply Mission, 2536, Massachusetts Avenue, N.W. Washington 8, D.C., United States of America, invites TENDERS for the following:
(a) TENDER ENQUIRY No. SE.53.
For the Supply of Pumping Sets, 1000 gallons per minute, Submersible or Borehole complete with Rising Main, Central Gear and Transformers.
(b) TENDER ENQUIRY No. SE.54.
For the Supply of Automatic and Semi-Automatic Lathes, Vertical and Horizontal; Drillers and Tappers; Circular and Band Saws, Threading Machines, Jig Bores, Millers; Shapers, Slotters and Planers for wood; Cylindrical, Surface and Tool Grinders, Saw Doctoring Equipment, Plate angle and Tube benders and cutters and Varnishing Plant.
(c) TENDER ENQUIRY No. SE.58.
For the Supply of Presses, Mechanical, Hydraulic, Automatic, Brake and Friction Screw, Shears for Plate strip, Sections and Circles. Notching Machines Automatic.
(d) TENDER ENQUIRY No. SE.59.
For the Supply of Machines for Transformers, Motors and Switchgears productions including Drying and Vacuum Ovens, Paper Tube Machine, Coil-winding machines, Paper-covering machines, Copper wire Brazing machines, Sandblast Equipment, Spray Painting Equipment, Oil treatment Plant, Oil Furnaces, Die Casting Machines and Riveting Hammers.
(e) TENDER ENQUIRY No. SE.60.
For the Supply of Portable Electric Tools, Drills, Screwdrivers and Shears. Gas cutting plant, Spot Welders and Flexible Shaft Motors.
(f) TENDER ENQUIRY No. SE.61.
For the Supply of Crane Weighing Devices and Wood Impregnation Plant.
Specifications, &c., can be obtained from the Co-ordination Branch, India Store Department, Government Buildings, Bromyard Avenue, Acton, London, W.3, at a cost of (a) £1 15s. 9d. per tender set; (b to f) 14s. 3d. per tender set, per tender enquiry. Tenders are to be returned direct to the India Supply Mission, 2536, Massachusetts Avenue N.W., Washington 8, D.C., United States of America, so as to reach them by (a) 7th July, 1959; (b) 14th July, 1959; (c) 16th July, 1959; (d) 21st July, 1959; (e) 23rd July, 1959; (f) 28th July, 1959.
Specimen copies of the above enquiries can be seen at Engineering Branch, India Store Department, Government Buildings, Bromyard Avenue, Acton, W.3, under the following references:
(a) S.3174/59/NSC/ENG.2.
(b) S.3175/59/NSC/ENG.2.
(c) S.3176/59/NSC/ENG.2.
(d) S.3177/59/NSC/ENG.2.
(e) S.3179/59/NSC/ENG.2.
(f) S.3178/59/NSC/ENG.2. E6032

WOKING URBAN DISTRICT COUNCIL

MAIN DRAINAGE—CONTRACT NO. 6

TO MANUFACTURERS OF CENTRIFUGAL PUMPING PLANT

TENDERS invited for MANUFACTURE, SUPPLY and ERECTION of 15 SETS VERTICAL UNCHOKABLE SEWAGE PUMPS, 3 SETS VERTICAL SUSPENDED SUMP TYPE RECIRCULATION PUMPS, and 3 VERTICAL DISINTEGRATORS. Duties range from 100–2000 gallons per minute against total heads of between 10ft. and 84ft., all in accordance with specification and drawings prepared by the Engineers, Messrs. John Taylor and Sons, Artillery House, London, S.W.1.
Specification and drawings obtainable from the Engineers upon payment of £5 (cheque only drawn in favour of above Council) returnable on receipt bona-fide Tender not subsequently withdrawn. Contract documents seen at Engineers' Offices or Council Offices.
Tenders, in plain sealed envelopes, endorsed "Pumping Plant—Contract No. 6," to Clerk of the Council, Council Offices, Woking, by noon, 20th July, 1959. E6066

COUNTY COUNCIL OF ESSEX

SAFFRON WALDEN COUNTY SECONDARY SCHOOL

RENEWAL OF HEATING BOILERS, &c.

Contractors wishing to submit a firm price TENDER for the above should forward their names, from which a panel will be chosen and provided with specifications.
The work consists of the RENEWAL of TWO HEATING BOILERS and OIL BURNERS and the INSTALLATION of INDUCED DRAUGHT FANS at an estimated cost of £3750.
Applications to reach the undersigned not later than 17th June, 1959.

H. CONOLLY, C.B.E., F.R.I.B.A.,
County Architect.
County Hall,
Chelmsford. E6040

EDUCATIONAL

AUTOMATION.—AUTHORITATIVE COURSES are now available in Digital and Analogue Computer Technology, Applied Electronics, Data Processing and Instrumentation up to professional level by home study. Individual enrolment or industrial group scheme enrolments accepted. Syllabuses and prospectus sent on request.—Write (Dept. S.E.8), E.M.I. Institute School of Electronics, College House, Kensington, London, W.8. E145 ▮

COMPANY MEETING

WORTHINGTON-SIMPSON LIMITED

RESULTS AGAIN A RECORD

The sixty-eighth annual general meeting of Worthington-Simpson, Ltd., was held on June 10 in London, SIR SAMUEL R. BEALE, K.B.E., M.I.Mech.E., chairman, presiding.
The following is an extract from the chairman's statement circulated with the report and accounts for the year to December 31, 1958:
I find it most gratifying to present to you results which are better even than last year's record figures. The Trading Profit of £1,181,674 shows an increase of £56,034 over last year's figure of £1,125,640 and, after making full provision for all charges, including taxation, a net profit for the year under review of £543,759 is shown against £493,095 for 1957.
Although the increase in the Trading Profit is most satisfactory, I feel it necessary to point out that rather less favourable trading conditions must be anticipated in respect of 1959 and the years that lie ahead. The peak results that have been obtained in this and recent years were due to a certain extent, to long term contracts for heavy plant, such as condensing and feed-heating equipment, occasioned by the post-war demands for increased electrical power. I have indicated in previous annual statements that our profits were influenced by certain of these large contracts reaching fulfilment in the year(s) in question.
In spite of the somewhat sombre remarks made above, the incoming business for our standard products so far this year shows an improvement over last year and our order book stands at its customary high level. Profit margins are, of course, narrowing due to increased production costs brought about by National Awards and it is not always possible, or advisable, to pass these on by raising our selling prices. In fact the policy of your Company is to absorb increased costs for as long as it is found practicable to do so. I am sure we can look forward to the future with every confidence and I have no reason to think that the results for 1959 will prove other than satisfactory even though, as I have remarked, the level of profits will show a marked drop compared with those of 1958.
In view of the record results this year and the very liquid position of your Company, your Board feels a slightly higher distribution of profits is justified and accordingly recommends that the final dividend on the Ordinary Shares be 10 per cent., less tax, making with the interim dividend of 7½ per cent., less tax, paid last December, a total of 17½ per cent., less tax, for the year on the Ordinary Share capital as doubled at the Extraordinary General Meeting held on the 11th June, 1958.
The report and accounts were unanimously adopted.

EDUCATIONAL

UNIVERSITY OF MANCHESTER

METROPOLITAN-VICKERS POST-GRADUATE BURSARIES

Applications are invited from honours graduates in Engineering, Physics or Mathematics for a number of post-graduate bursaries of a value normally within the range of £350–£700 per annum, although this maximum may be exceeded in certain cases. The bursaries are tenable for research and advanced study in the departments of Electrical and Mechanical Engineering in the Faculty of Science or of Technology.—Applications, naming the department and Faculty in which the candidate proposes to work, should be sent not later than July 1st, 1959, to the Registrar, The University, Manchester, 13, from whom further particulars and forms of application may be obtained. E6027 ▮

TECHNICAL HOME STUDY COURSES

For A.M.I.Mech.E., A.M.I.Chem.E., A.M.I.M.I., A.F.R.Ae.S., C. & G., &c.

OVER 50 FIRST PLACES and more than 2000 Passes have been secured by T.I.G.B. Students at Professional Engineering Examinations. We have a wide range of exclusive Home Study Courses in all branches of Engineering—Mechanical, Electrical, Aeronautical, Automobile, Chemical, Gas, Radio, and Television, Draughtsmanship, &c. Textbooks, blueprints, &c., are provided and, if desired, fees may be paid by moderate instalments.—Write (stating subject of interest) for copy of 110-page Prospectus FREE and without obligation.

THE TECHNOLOGICAL INSTITUTE OF GREAT BRITAIN
(Dept. 76),
29 WRIGHT'S LANE, LONDON, W.8.
E102 ▮

A.M.I.MECH.E., B.Sc., City and Guilds, &c. Guarantee Postal Courses for all Exams. and Technical Divisions from Elementary to Degree standard including Automation Techniques. Approximately 95 per cent. successes. 148-page prospectus free on request.—B.I.E.T. (Dept. 22), 29, Wright's Lane, London, W.8. E114 ▮

ELECTRONICS, covering practical and theoretical aspects, basic principles, industrial applications, electronic apparatus, &c. Guaranteed coaching for Brit.I.R.E., City and Guilds, &c. Study at home under highly qualified tutors.—Write for free book: International Correspondence Schools, 71, Kingsway (Dept. 446A), London, W.C.2. E157 ▮

Classified Advts. continued on page 94

SITUATIONS VACANT

APPLICANTS ARE ADVISED TO SEND COPIES NOT ORIGINALS, OF THEIR TESTIMONIALS UNLESS OTHERWISE REQUESTED.

A SALES SECTION LEADER is required by Hydraulics and Pneumatics, Ltd., Villiers Street, Wolverhampton, to introduce a new range of Compressors for Automotive Industrial and Refrigeration use. Specialised knowledge of the Product and the Market is an essential. Responsible and progressive position to a man of initiative ready to assume responsibility. E6074 A

AN IMPORTANT NATIONAL ORGANISATION embracing the Engineering Industry requires an experienced TRAINING OFFICER to advise its constituent Associations on apprentice training and organisation.—Apply, in confidence, stating qualifications, age, &c., to BOX No. E6029, "The Engineer." A

ASSISTANT CIVIL ENGINEERING ESTIMATOR required by Civil Engineering Contractors at their Newcastle office. Applications are invited from candidates aged 28 to 40, possessing H.N.C. or equivalent in Civil Engineering, and with at least two years' experience on sites and three years of C.E. estimating. Pension scheme operated.—Write, giving full particulars and stating salary expected, to Manager, HOLLOWAY BROS. (LONDON), LTD., 44a, Great North Road, Newcastle upon Tyne, 2. E6058 A

ASSISTANT ENGINEER required for tube manufacturing concern near Leicester. Age range 23/24. Candidates should preferably have an electrical background, although this is not absolutely essential, and minimum qualifications required are Higher National Certificate or University Degree. The successful applicant will be responsible for new installations and the development of existing plant. This is an interesting opportunity for a young man who wishes to widen his experience in a progressive and stable industry.—Applications, giving full details of experience, qualifications and salary required, should be addressed to the Chief Engineer, TUBES, LTD., Desford Lane, Kirby Muxloe, Nr. Leicester. E5968 A

ASSISTANT ENGINEER required for tube manufacturing concern near Leicester; age range 23/24. Candidates should preferably have an electrical background, although this is not absolutely essential, and minimum qualifications required are Higher National Certificate or University Degree. The successful applicant will be responsible for new installations and the development of existing plant. This is an interesting opportunity for a young man who wishes to widen his experience in a progressive and stable industry.—Applications, giving full details of experience, qualifications and salary required, should be addressed to the Chief Engineer, TUBES, LTD., Desford Lane, Kirby Muxloe, Nr. Leicester. E6044 A

ASSISTANT POWER MANAGER

required by the United Kingdom Atomic Energy Authority, at Calder Hall Nuclear Power Station, to assist the Power Manager in the operation of turbo-alternators, heat exchangers, and M.V. and E.H.V. switchgear associated with the station.

A recognised engineering apprenticeship, corporate membership of a senior engineering institution, or equivalent, and several years experience in a senior position in the operation of a large steam power station are essential.

Salary between £1345 and £1800 according to qualifications and experience.

Contributory Superannuation. Staff housing scheme.

Send postcard for application form, quoting reference 3109/J1, to Works Secretary, U.K.A.E.A., I.G., Windscale and Calder Works, Sellafield, Seascale, Cumberland.

Closing date: 22nd June, 1959.

E6205 A

CIVIL ENGINEERING ASSISTANTS required for Head Office and Site Vacancies in connection with electric power projects in Scotland. Preference for applicants with Engineering Degree or exemption from Parts I and II of Institution examination.—Reply, giving age, qualifications and experience, to JAMES WILLIAMSON AND PARTNERS, 219, St. Vincent Street, Glasgow. E5896 A

COMPETENT PRACTICAL ENGINEER required for PLYWOOD FACTORY in West Africa, to be responsible for maintenance, also to draw plans for expansion scheme, supervise extensions, erect machinery, &c.; some knowledge of steam boilers and electronics necessary. Tours of 15 months, thereafter three months' home leave and passages and living accommodation provided.—Write, giving full particulars of experience, salary, &c., to BOX No. E2441, "The Engineer." A

CONSULTING ENGINEERS, engaged on a variety of structural design projects at home and overseas, require first-class ASSISTANTS for their London office; 5-day week and luncheon vouchers.—Apply in writing, giving details of age, qualifications and experience, to MAURICE NACHSHEN and PARTNERS, 58, Victoria Street, London, S.W.1. E5996 A

CRAVENS, LTD., SHEFFIELD, urgently require DRAUGHTSMEN with experience in General Engineering, Rolling Stock or Machine Tool design. Age 25–30. Minimum qualification O.N.C. Pension Scheme, &c.—Apply Personnel Manager. E2447 A

DESIGN/DRAUGHTSMAN required by rapidly expanding engineering company for new factory to be erected in East Anglia. The duties and responsibilities require a knowledge of plant layout, mechanical handling, automatic feed mechanisms, coupled with general factory services. Previous experience in these fields essential and require qualifications to H.N.C. level. Knowledge of production engineering or time study would be an advantage. The post initially tenable in Essex and later in East Anglia. The company offer attractive working conditions and operate a part-contribution pensions and life assurance scheme, and a salary commensurate with age, experience and qualifications.—Applications, giving full details of career, should be made to BOX No. E6008, "The Engineer." A

DESIGN ENGINEER required. Applicants with experience on paper-making machinery preferred.—BOX No. E6047, "The Engineer." A

DESIGN DRAUGHTSMAN required for mechanical design of nucleonic instruments. Pleasant working conditions. Excellent rates of pay.—Apply Chief Draughtsman, ISOTOPE DEVELOPMENTS, LTD., Beenham Grange, Aldermaston, Berks. Tel.: Woolhampton 451. E152 A

DESIGN ENGINEER

Applicants are invited for the following superannuated appointment in the Midland Area for a DESIGN ENGINEER to take complete charge of development of High Speed Turbo machines. Age 30–40. Experience in similar work essential. Engineering Degree desirable. Write in confidence, with full personal particulars and details of qualifications and experience.—BOX No. E5958, "The Engineer."

A

DESIGN ENGINEER required with experience in heat transfer calculations and design of small compact heat exchangers.—Write, stating age, details of experience, &c., to Chief Designer, DELANEY GALLAY, LTD., Vulcan Works, Edgware Road, Cricklewood, N.W.2. GLAdstone 2201. E6049 A

DRAUGHTSMAN

Interesting position offered to skilled Draughtsman in Birmingham Organisation handling refrigeration and air conditioning plant.

TECHNICIANS

Development and technical opportunities are also offered in this expanding business.

Write, giving comprehensive but brief details, to Chief Engineer.—BOX No. E2435, "The Engineer." A

DRAUGHTSMAN/JUNIOR MECHANICAL ENGINEER, preferably with N.C. or H.N.C., age 25 or over, for Birmingham office of Major Oil Company. Commencing salary approximately £800 per annum. Only applicants with good practical background, capable of working on own initiative, need apply.—BOX No. E6081, "The Engineer." A

EDITORIAL ASSISTANT required for monthly journal specialising in world hydro-electric development. Should be young engineer, preferably civil and with some practical experience, with an aptitude for technical writing. Some knowledge of languages an advantage.—Apply, The Editor, "Water Power," 33, Tothill Street, S.W.1. E6041 A

HAWKER SIDDELEY—INDUSTRIAL DIVISION BRUSH ELECTRICAL ENGINEERING CO., LTD.

The General Engineering Division of the above-named Company which is responsible for the design and layout of complete steam and diesel power stations, factory electrification projects and the application of electrical energy to industrial uses generally, wishes to recruit a

SENIOR ENGINEER

The work is interesting and varied and offers unique opportunities for the exercise of initiative and engineering ability.

Applicants must have corporate membership of the Institution of Mechanical and/or Electrical Engineers and have had varied experience in industry and/or public electricity supply undertakings. Experience in the handling of comprehensive contracts in this country and overseas will be an advantage.

An attractive salary will be offered and employment conditions include a contributory pension scheme. There are also vacancies for Junior Engineers and Draughtsmen (Electrical and Mechanical), details of which may be obtained on application.

Please write to:
Chief Personnel Officer,
Brush Electrical Engineering Co., Ltd.
Loughborough, Leics. E6050 A

LEADING LOADING SHOVEL MANUFACTURERS HAS VACANCY for a DESIGN DRAUGHTSMAN for the Design and Progressing of New Developments in Hydraulic Loading Shovels. Applicants should have experience in medium general engineering fabrication and transmission design and should be able to work with a minimum of supervision. H.N.C. minimum qualification.

Apply in writing to Chief Designer, F. E. WEATHERILL, LTD., Tewin Road, Welwyn Garden City, Herts. E5980 A

MANCHESTER CORPORATION TRANSPORT DEPARTMENT require suitably qualified WORKS SUPERINTENDENT, to take charge, under the Works Manager, of the Department's Central Repair Works. A.M.I.Mech.E. or equivalent would be an advantage. Salary, £1065 to £1220 per annum.—Forms of application may be obtained, together with details of duties, &c., from the General Manager, 55, Piccadilly, Manchester, 1, and should be returned not later than Wednesday, 24th June, 1959. E6080 A

MECHANICAL AND CIVIL ENGINEERING DRAUGHTSMEN required for a drawing-office engaged on all types of work connected with mining, quarrying, hydraulics and industrial building construction. A superannuation scheme is in operation.—Applications, stating qualifications, experience and salary required, should be made to the Chief Engineer, Messrs. English Clays Lovering Pochin and Co., Ltd., 14, High Cross Street, St. Austell, Cornwall. E6038 A

MECHANICAL ENGINEER required for investigating problems in applied mechanics in industry. Mathematical background and some knowledge of electronics desirable, minimum qualifications H.N.C. Good working conditions and prospects.—Send full details, including age, qualifications, experience and present salary in confidence to the Secretary, PERA, Melton Mowbray. E5999 A

MECHANICAL ENGINEER, Degree or A.M.I. Mech.E., to be responsible for design and technical sales of couplings. Previous experience should preferably include responsibility for project development. Competency as a design and development engineer matched with personality and enthusiasm are essential. This is a senior appointment with commensurate salary. Excellent life assurance and pension scheme in operation. Location: Leicestershire. Write fully about your education and career in strict confidence.—BOX No. E6079, "The Engineer." A

PIPEWORK DRAUGHTSMAN (30–40), H.N.C. or equivalent, is required by a well-known group of companies in the London area. The successful applicant will have considerable experience in the layout of chemical process plant and services. Appropriate salary will be paid. Pension and profit participation schemes in operation.—Write, giving full details of age, experience and qualifications, and quoting reference PWD 30, to BOX No. E6042, "The Engineer." A

RICHARD THOMAS AND BALDWINS (SALES) LIMITED

invite applications for a

SALES ENGINEER

for technical liaison between the Sales Company, the Works of the R.T.B. group and the consuming industry in both Home and Export markets. The position offers a wide scope of interest in the technical development and commercial application of the steel products of the Company.

Applicants should possess a University Degree or equivalent qualification in Engineering or Metallurgy. Some industrial experience is essential and a knowledge of sales would be advantageous. The preferred age limit is 28 to 32 years.

The successful candidate will be attached to the Sales Engineering Dept., based in London, but will be expected to visit the various Works of the Company and customers' plants as required.

Brief details of education, qualifications and experience should be sent to:—

Central Staffing Department,
RICHARD THOMAS AND BALDWINS LTD.,
47, Park Street,
London, W.1.

E6061 A

SENIOR DESIGN DRAUGHTSMEN capable of making original designs of Wire Drawing Machinery, Bar and Tube Machinery, &c.

High salary and bonus, according to experience. Permanent, pensionable appointments.

Please reply in writing or telephone to Chief Draughtsman (Metal D.O.), Manchester, BLAckfriars 3613 or 6392, for further details.

SIR JAMES FARMER NORTON AND CO. LTD.,
ADELPHI IRON WORKS,
SALFORD, 3,
Lancs. E2445 A

SENIOR DRAUGHTSMAN required for North London firm of Mechanical Engineers. Experience in Mechanical Handling and/or Bottling Plant an advantage. Initial salary not less than £1000 p.a. for first class men of initiative and responsibility. Canteen facilities. Pension Scheme.—Apply with full particulars to BOX No. E6026, "The Engineer." A

SENIOR DRAUGHTSMAN/DEVELOPMENT ENGINEER required with experience in machine tools as applied to punching, shearing and guillotine machines. Applicants must have sound workshop and drawing office experience. The position is progressive, offers good opportunities and a good salary will be offered to the right man. DRAUGHTSMAN required with machine tools experience as applied to punching, shearing and guillotine machines. Applicants must have sound engineering training and be prepared to work on own initiative. The above positions are pensionable and in the Manchester area.—BOX No. E6030, "The Engineer." A

SENIOR PLANT SALES REPRESENTATIVE for concrete machinery, shuttering, quarry plant, compressors, earth-moving equipment, for the South and West of England. Technical experience and ability to negotiate with large contractors and public authorities essential.—BOX No. E6048, "The Engineer." A

TECHNICAL SALES REPRESENTATIVE required for General Engineering, selling, Medium and Heavy Precision. Applicants should be between the age of 35–45 and must have first class contacts and sound engineering background. This is a progressive appointment with promising prospects for a man of initiative.—BOX No. E2443, "The Engineer." A

SENIOR ENGINEERING ASSISTANT—MECHANICAL AND ELECTRICAL—required by London consultants. Age range about 40–45. Professional qualifications and previous professional work advantageous. Experience essential in layout of industrial plant with ancillary services. Post carries prospects as to position and remuneration. Starting salary necessarily to be adjuged on qualifications and experience, so please detail in application these particulars.—BOX No. E6045, "The Engineer." A

TEST HOUSE ENGINEER required for organising and running of test house in established diesel manufacturing Company in East Anglia. Applicant should have first-class knowledge of test bed procedure, and should also be a fully experienced electrical engineer. Ability and personality to organise and take full responsibility for testing programmes. University or H.N.C. qualifications an advantage. Good salary will be paid to the right man.—Applications in writing, stating age, qualifications and experience to Labour Officer, Box TH775, A.K. Advtg., 212a, Shaftesbury Avenue, London, W.C.2. E6051 A

THE BEECHAM GROUP have vacancies in the London area for two Senior DRAUGHTSMEN, H.N.C. or equivalent, with experience in plant layout and general engineering. Appropriate salary will be paid. Profit participation and non-contributory pension schemes are in operation. Applications in writing only, giving full details of age, qualifications and experience, and quoting reference SD/31, to be forwarded to the Personnel Controller, Beecham Group Limited, Beecham House, Great West Road, Brentford, Middlesex. E6073 A

GOVERNMENT SERVICE
ENGINEERING DRAUGHTSMEN

Government Communications Headquarters have vacancies at Cheltenham for Mechanical and Electrical Draughtsmen with design experience in any three of the following categories:—

Electronic equipment (rack mounted type, &c.).
Electrical work and small mechanisms.
Micro-wave equipment.
Fabricated parts, sheet metal work, outdoor structures.

Applicants should also have served a recognised engineering apprenticeship or have equivalent workshop knowledge, and preferably hold the Ordinary National Certificate.

There are opportunities for permanent and pensionable appointments and advancement to higher drawing-office posts. Facilities given to study for National Certificates and other Courses in approved cases.

Three-and-a-half weeks' annual leave, plus all public and privilege holidays.

Write to:
Personnel Officer,
G.C.H.Q. (D.O./15),
53, Clarence Street,
Cheltenham,
Glos. E6065 A

DRAUGHTSMEN

Experienced in the design of compressors or pumps, required by well-established and progressive company situated in the Midlands. Good salary paid to suitable applicants.

Apply BOX No. E6078, "The Engineer."

A

A. MONK & COMPANY
LIMITED
WARRINGTON, LANCS.

REQUIRE SENIOR AND JUNIOR SITE ENGINEERS.

Applications invited from those who are experienced in the various duties and responsibilities associated with these positions.

Full details of age, experience, etc., to Mr. H. Hudson, Personnel Department, Padgate, Warrington.

E5938 A

SITUATIONS VACANT

CHEMICAL ENGINEER

for

PRODUCTION MANAGEMENT

Brown and Polson Ltd., Trafford Park, Manchester, 17, require a Chemical Engineer with Degree or equivalent qualifications, for production management appointment.

This position offers considerable experience of a wide variety of Unit operations in a modern factory, operating large-scale Batch and Continuous processes.

Candidates should be between 26 and 30, having had at least three years' relevant experience in the process or chemical industries. Attractive salary and employee benefit schemes—promotional prospects are good.

Applications, in some detail, should be addressed to the Personnel Adviser.

E6039 A

SITUATIONS VACANT

VICKERS-ARMSTRONGS (ENGINEERS), LIMITED

A vacancy exists at their Barrow-in-Furness Works for a

CHEMICAL ENGINEER

with a specialised knowledge of the manufacture of latex foam from Butadiene Styrene.

The engineer should have suitable technical qualifications up to at least pass degree standard in chemical engineering, and have several years' experience in the design of equipment for the above industry.

Salary appropriate to qualifications and experience is offered, and there is a contributory Pension Fund.

The town is pleasantly situated on the coast adjacent to the Lake District. The Company has a well-appointed Sports Club and Grounds, with comprehensive recreational facilities, both social and sporting. An illustrated guide to the town and surroundings can be sent on request.

All applications should be addressed to the Engineering Technical Manager, VICKERS-ARMSTRONGS (ENGINEERS) LTD., Naval Construction Works, Barrow-in-Furness, Lancashire.

E6046 A

SITUATIONS VACANT

PA

PERSONNEL ADMINISTRATION LIMITED
MANAGEMENT CONSULTANTS

Our Appointments Division has been asked to advise on the following post

GENERAL MANAGER **Engineering**

for a prosperous and well-established company in the South of England manufacturing a wide range of engineering products. The General Manager will be answerable to the Managing Director and will have complete responsibility for the efficient day-to-day operation of the company. A starting salary of up to £3500 is offered and there is an exceptional opportunity for promotion to Board level in the future. Company car and contributory pension. Applications are invited from men around the age of 40 who can offer experience of production management at a senior level in the engineering industry and considerable administrative ability. A professional engineering qualification and experience of sales work are also desirable. (Ref. 3277/TE)

The identity of candidates will not be revealed to our clients without their prior permission. Applicants should forward brief details quoting the reference number to :

PERSONNEL ADMINISTRATION LIMITED
APPOINTMENTS DIVISION
2 ALBERT GATE, LONDON, S.W.1.

E6054 A

LIL

LAPORTE TITANIUM LIMITED, a member of the Laporte Group of Companies, invites applications from those with appropriate qualifications for the post of

PROCESS CONTROL ENGINEER

to carry out the development of process control and automation at their Stallingborough works.

Applicants should be qualified and have practical experience of the application of modern control techniques in heavy process industries and should preferably have some knowledge of Chemical Engineering. Age 27-35.

Salary will be in the range £1000-£1800 p.a., according to age, qualifications and experience. The post is permanent and progressive, and there is a Company pension scheme.

Applications giving full details of age, qualifications and experience, and quoting Ref. LTS/TE1/47 should be made to The Group Personnel Manager, LAPORTE INDUSTRIES LIMITED, Hanover House, 14, Hanover Square, London, W.1.

E6053 A

CENTRAL ENGINEERING SHOPS MANAGER

In view of a pending retirement a MANAGER is required for the Central Engineering Shops to maintain a high standard in the technical capacity of the shops in order to provide a repair service to the Steel Division.

He will be in charge of several large repair shops concerned with fitting and machining, welding and smithing, boilermaking, carpentry, diesel locos. maintenance, and wagon repairs.

His duties will involve the management of over 1000 employees, labour negotiation, organisation, administration and financial measurement.

All applications will be treated in strict confidence.

Superintendent, Personnel Services,
THE STEEL COMPANY OF WALES LIMITED
(Steel Division),
Abbey Works, Port Talbot, Glam.

E6021 A

SENIOR MECHANICAL ENGINEER

In the Engineering Division of

THE ATOMIC WEAPONS RESEARCH ESTABLISHMENT

This post is for a Senior Engineer of proven organisational ability with wide experience in the precision engineering field. Corporate Membership of a senior engineering institution is required.

Duties include the supervision and control of inspection and planning departments of a large workshop organisation serving a Research and Development Establishment. The organisation covers a wide range of the most up-to-date engineering facilities, including Metrology. The post calls for a man of wide experience and flexibility.

Salary will be within the range £2400—£2900

Contributory Superannuation Scheme. A modern house with garage, or, alternatively, substantial assistance with house purchase, will become available for married officers living beyond daily travelling distance.

Postcards for application forms to the Senior Recruitment Officer at
THE ATOMIC WEAPON'S RESEARCH ESTABLISHMENT ALDERMASTON BERKS.

Please quote ref 2284/25

E6023 A

PILKINGTON BROTHERS LIMITED

GLASS MANUFACTURERS

ENGINEERS

Mechanical Engineers are required to develop processes for pressing glass including :

(*a*) Machine design and operation—mainly pneumatic and hydraulic mechanism.
(*b*) Study of materials for and design of tools for pressing glass.
(*c*) Heat treatment including toughening.

The preferred age range is 26-33, and qualifications required are a good honours degree and practical training in Mechanical Engineering.

Initial salaries are determined by age, qualifications and experience. Superannuation, five-day week, assistance with house purchase and excellent recreational facilities are available.

Application is by form obtainable from—

Personnel Officer (Graduate Recruitment),
Pilkington Brothers, Limited,
St. Helens,
Lancashire.
Please quote reference TD/RH.

E6063 A

The Harland Engineering Co., Ltd., B.E.P. Works, Alloa, Scotland, has vacancies for two

SENIOR METHODS PLANNING ENGINEERS

one for welding and fabrication, and one for armature winding, notching and electrical core-building. Applicants must be experienced men with thorough knowledge of modern heavy/medium manufacturing techniques in their respective fields, and should preferably be qualified to H.N.C. standard. Positions are permanent and pensionable.—Write in confidence, stating full personal details, to the Works Manager, Department E., B.E.P. Works, Alloa.

E6060 A

Classified Advts. continued on page 96

ENGLISH ELECTRIC AVIATION LTD.

GUIDED WEAPONS DIVISION

LUTON—BEDS : STEVENAGE—HERTS : LONDON DESIGN OFFICE—FINSBURY SQ., E.C.2.

SENIOR DESIGNERS & DRAUGHTSMEN

FOR NEW DEVELOPMENT WORK

We are again increasing our engineering and design effort because of expanding requirements of our major development projects.

We have the following important positions to fill in our Guided Missile organisation, one of the largest and most comprehensively equipped in Europe. The Company forms part of one of the largest engineering groups in the United Kingdom with many diverse products.

VACANCIES IN LUTON, STEVENAGE AND LONDON

Senior Mechanical Designers

Qualified men with sound practical design background are required for senior posts. Duties involve responsibility for the work of design and detail draughtsmen on a wide range of mechanical and electro-mechanical equipment or in the more specialised field of precision instruments. A knowledge of dynamic design principles and practice is required for application to launching systems, handling gear, packaging, transport, field assembly equipment and airborne electro-mechanical and servo equipment.

Senior Hydraulic Designers

Vacancies similar to those above, but requiring experience in high and low pressure hydraulic control equipment for use on airborne electro-mechanical and servo equipment, airborne power supply systems, ground-based control equipment and test gear.

Senior Electronic Designers

Similar vacancies for men with experience in the design of electrical and electronic equipment including airborne guidance equipment, ground control and launching equipment, telemetry and test gear.

Senior Airframe Designers and Stressmen

Qualified men with experience in design or stress analysis on missile structures or airframes are required for work on problems involved in high speed flight and dynamic ground-based structures.

Electrical, Electronic, Mechanical, Hydraulic, Airframe and Instrument Draughtsmen

Young men with workshop and drawing office experience, preferably taking courses of study leading to H.N.C. required for detail design development work in our drawing offices.

HOUSING AND AMENITIES

Assistance may be available to enable you to obtain housing in the Luton and Stevenage areas.

The Company operates a contributory pension and life assurance scheme for which staff are eligible after an initial qualifying period.

There are sports and social clubs with extensive grounds and a great variety of well-supported activities.

Enquiries: We should be glad to hear from you. If interested please write in confidence to Dr. D. A. Layne, Dept. CPS, Marconi House, Strand, London, W.C.2 quoting Ref. E1316Q.

'ENGLISH ELECTRIC'

E6033 A

SITUATIONS VACANT

NORRIS CONSULTANTS LTD.,

in view of a two-year expansion programme, require for their London and Bristol Offices and elsewhere in the U.K., Senior and Junior Engineers, Designers and Draughtsmen in the following fields.

CIVIL ENGINEERING & SERVICES DIVISION
Reinforced Concrete, Heating, Ventilating, Air Conditioning, Refrigeration, Pipework and General Services, Structural Steelwork, Electrical (Heavy and Light current).

PRODUCTION & MECHANICAL DIVISION
Special purpose machines, Transfer Systems, Jigs and Tools, General mechanical, Mechanical Handling.

Salary scales up to high level in accordance with age, experience, technical and professional qualifications. Pension and Insurance scheme.

Write or telephone : 76, Victoria Street, London, S.W.1. Tel. : VIC 4674, or Beacon House, Queens Road, Clifton, Bristol. Tel. : Bristol 3-6817.

E6087 A

UNILEVER LIMITED

QUALIFIED ENGINEER

A Unilever Company requires a qualified Engineer for Central Africa, who can speak French. Maximum age 32. Marriage no bar.

Minimum qualifications : B.Sc. in Engineering or Graduate of Mechanical and Electrical Engineering Institutions.

The successful applicant must be prepared to face hard, practical work during his training period in factories processing various plantation products. The job offers plenty of scope for advancement, eventually to an administrative position.

Starting salary between £1800 and £2500 per annum, depending on qualifications and experience.

Full description of the position and conditions of service will be discussed during interview. Apply in writing, stating age, education, qualifications and experience, to : Personnel Division (MWG/413), Unilever Limited, Unilever House, Blackfriars, London, E.C.4.

E6007 A

CENTRAL ELECTRICITY GENERATING BOARD

Applications are invited from ENGINEERS and SCIENTISTS for positions in a research team located at Littlebrook Power Station, Dartford, Kent.

The work being carried out at Littlebrook chiefly concerns the investigation of an advanced steam cycle and the first stage of the experimental plant is now nearing completion. This plant employs both oil and pulverised coal fuel firing and superheats up to 100 klb. of steam per hour to a temperature of 1400 deg. Fah. Very interesting work will arise in the fields of Mechanical Engineering, Chemical Engineering, Fuel Technology, &c., and the persons appointed must be prepared to tackle problems of a diverse nature.

Candidates for the following two vacancies should preferably have a good Honours Degree and have had already several years' research experience.

(*a*) MECHANICAL ENGINEER
To be concerned in the first instance with work on steam, heat exchangers, compressors, design of mechanical experimental plant, &c., and it is anticipated that the work will eventually broaden and cover a wide field.

(*b*) COMBUSTION ENGINEER OR FUEL TECHNOLOGIST
To be concerned in the first instance with combustion problems arising out of the production of very high temperature steam.

Vacancies also exist for newly qualified graduates and graduates with limited research experience to assist the persons appointed in (*a*) and (*b*) above.

Salaries on scales within the ranges £1245–£1835 per annum and £610–£1350 per annum, according to duties and responsibilities. Ref ENR/218

RESEARCH LABORATORIES, LEATHERHEAD, SURREY

GENERATING PLANT SECTION

ENGINEERS and PHYSICISTS required to carry out aerodynamics and fluid flow investigations.

Successful candidates will be required to work on a wide range of problems including model investigations, detailed studies of the flow patterns in tube banks of heat-exchangers and in the fuel element channels of nuclear reactors, and the accurate measurement of large flows of liquids and gases in power stations.

Salaries on scales within the overall ranges £1195–£1775 p.a., and £570–£1300 p.a., according to duties and responsibilities.

For the senior positions an Honours Degree or Membership of the Institute of Physics, and research experience in an associated field is essential ; for the other vacancies a Pass Degree or equivalent will be acceptable. Ref. ENR/206

MECHANICAL AND CIVIL ENGINEERING SECTION

ENGINEERS required to join a stress analysis group that is being formed to study engineering problems arising in the generation of electricity.

A good theoretical background, with the ability to carry out experimental research programmes, is necessary. Some knowledge of photo-elastic techniques is desirable for some of the posts concerned.

Minimum qualifications required are a degree or Higher National Certificate in Engineering or Physics with preferably some research or industrial experience, although graduates direct from University are not excluded.

Salaries on a scale within the range £570–£1300 p.a. according to duties and responsibilities. Ref ENR/207

Application forms obtainable from the Personnel Officer, 24–30, Holborn, London, E.C.1, should be completed and returned by 30th June. Envelopes should be marked "Confidential Ref" quoting relevant reference number. E6077 A

SITUATIONS VACANT

MECHANICAL/ELECTRICAL ENGINEER

required by

DAVY AND UNITED ENGINEERING COMPANY LIMITED

to join an expanding department engaged upon practical research in the field of Steelworks Plant.

The research team is being built up with Engineers of varied backgrounds and the present requirement is for either an Electrical Graduate with a few years' industrial experience in Heavy Mechanical Engineering or for a Mechanical Graduate, preferably with experience in the Electrical Engineering industry.

Applications are invited from candidates of suitable background having minimum qualifications of a Degree in Mechanical or Electrical Engineering or Physics.

Good conditions in modern accommodation, contributory pension scheme. Apply with full details in writing to :—
Personnel Department,
Davy and United Engineering Co. Ltd.,
Darnall Works,
Sheffield, 9. E6064 A

CHIEF DRAUGHTSMAN DESIGNER

Vacancy occurs for an engineer experienced in machine design preferably with reference to foundry equipment though this is not essential. Qualifications should include Higher National Certificate, good drawing office experience and knowledge of work study. Good prospects for man with initiative. Bedford area. Age limit 30–45 years.—BOX No. E6052, "The Engineer."

A

SITUATIONS WANTED

REPRESENTATIVE.—Experienced Engineer Representative desires situation. South or South-East. Write : Wood, 9, Ronver Road, S.E.12. E2444 B

HYDRAULIC ENGINEER, age 39, seeks position as Sales Engineer. Wide experience in all types of hydraulic machinery for both marine and industrial applications. At present in executive position, has travelled extensively at home and abroad.—BOX No. E2448, "The Engineer." B

BUSINESSES and PREMISES

ENGINEERING BUSINESS REQUIRED

as a Going Concern.

The main factory must be equipped for steel fabrication of ¾ inch thickness or over.

There should in addition be several mechanical and auxiliary workshops.

Labour force: 80-120 men.

Covered area: 40,000 sq. ft. approx.

Total site area: 3-5 acres.

Full details please to Retained Surveyors

FULLER, HORSEY SONS & CASSELL
10, Lloyd's Avenue,
London, E.C.3. (ROYal 4861)

E6082 L

FOR HIRE

BELLMANS MASTS FOR HIRE, to lift from 1 to 20 tons, 30ft. to 150ft. Blocks and tackle. Hand-operated winches. From £1 per day.—BELLMAN'S (Phone : SLOane 5259), Hobart House, Grosvenor Place, S.W.1. E103 K

BUSINESS OPPORTUNITIES

REMPLOY SPONSORSHIP SCHEME.—Send for details which show an attractive proposition to manufacturers.—Write to the Managing Director, Remploy, Ltd., 25–28, Buckingham Gate, S.W.1 or telephone VICtoria 6621 (12 lines). E155 O

SUB-CONTRACTING

CASTINGS.—We can save your porous castings, ferrous or non-ferrous, by an approved impregnation process ; sample castings treated ; A.I.D. approved. —Recupero, Ltd., 66, South Harrow Viaduct, Harrow, Middlesex (Phone Byron 1178). E109 MW

KELLERING AND CAM PROFILING capacity up to 8ft. by 6ft. or 6ft. diameter.—ARMYTAGE BROS. (KNOTTINGLEY), Ltd., The Foundry, Knottingley, Yorkshire (Telephone : Knottingley 2743/4). E116 MW

MACHINERY Etc. WANTED

LABORATORY EQUIPMENT. Wanted—Metallurgical Microscope suitable for micro and macro examination of steel. Camera attachment essential. Full details.—BOX No. E2450, "The Engineer." F

FOR SALE

600

BOILERS

TWO COCHRAN "SINUFLO" double-pass, 10ft. 9in. by 15ft. 8in. by 22ft. 7in., 16,800/18,000 lb/hr., 120 p.s.i.
JOHN THOMPSON treble-pass, super economic, 11ft. by 16ft. by 21ft., 14,500/15,150 lb./hr., 120 p.s.i.
TWO FOSTER YATES AND THOM double-pass, 9ft. 9in. by 15ft. 6in. by 20ft. 6in., 12,000 lb/hr., 160 p.s.i.
TWO JOHN THOMPSON treble-pass, 9ft. 6in. by 14ft. by 19ft., 9500 lb./hr.
Oil-firing or automatic stokers can be supplied with above.

GEORGE COHEN,
Sons and Co. Ltd.
Wood Lane, London, W.12
(Shepherds Bush 2070).
Stanningley, Nr. Leeds.
(Pudsey 2241.) E203 G

SPECIAL OFFER

COMPLETE INERT GAS GENERATING PLANT. Total Capacity 2600 cubic metres per hour, including :
2 HOLMES "KEMP" variable capacity Generators, each 600 cubic metres per hour.
1 HOLMES "HARRISON" constant capacity Generator, 1000 cubic metres per hour.
All complete with "Connersville" Boosters, Auto Controls, Instrument Board, &c. All new 1952.
COMPRESSOR INSTALLATION comprising :
7 REAVELL Motor-Driven Gas Compressors ranging in capacity from 65 c.f.m. at 135 p.s.i.g. to 470 c.f.m. at 25 p.s.i.g. with aftercoolers.
Also
4 Vertical M.S. Receivers 16ft. high by 6ft. diameter for 135 lbs. working pressure.
VALVES, GAUGES, INSTRUMENTS, PIPEWORK, &c. FOR SALE AS ONE COMPLETE PLANT OR AS SEPARATE UNITS AT VERY ATTRACTIVE PRICES.

G. E. SIMM (MACHINERY), LIMITED,
27, Broomgrove Road, Sheffield, 10.

E6031 G

FRED WATKINS (ENGINEERING) LTD.

800-ton Fielding Vertical 4-column Downstroke Hydraulic Press, ram 23in. dia. by 14in. stroke. Daylight 2ft. 3in., Platens 5ft. 4in. by 4ft. 4in., with 2 pumps and controls, motorised 400/3/50.
Fielding 500-ton Vertical Downstroke Hydraulic Press, 42in. by 36in. platens, with pumps and motors.
Fielding 200-ton ditto. 3ft. stroke, with pumps and motors (5 available).
Fielding 100-ton ditto, 4ft. to 5ft. stroke, with pumps and motors.
Two 73ft. 4in. by 5ft. Kilns or Dryers, with Crofts Reduction Gear and 27 h.p. motor.
Two 26ft. by 4ft. Rotary Cooler or Dryers, with reduction gear and motor.
Available at low prices ex present sites to save cost of bringing into stock.

FRED WATKINS (ENGINEERING), LTD., COLEFORD, GLOS. E151 G

FOR SALE

Danks 7ft. diameter by 15ft. 6in. long High-velocity Economic Boiler, 3600 lb. evaporation, 300 p.s.i. working pressure, with Oldbury Chain Grate Stoker. New 1952.
Danks 7ft. 6in. dia. by 14ft. Medium Velocity ditto, about 4500 lb. evaporation, 100 p.s.i. working pressure. With Oldbury Chain Grate Stoker. New 1952.

JOSEPH PUGSLEY AND SONS LIMITED, BRISTOL, 5.
Tel.: Bristol 56037. E6075 G

Classified Advts. continued on page 98

WELDED STEEL PLATEWORK
In ¼" to ½" thick Mild Steel

PRESSURE VESSELS
TANKS & CYLINDERS
CHIMNEYS
DRYERS
HOPPERS
CYCLONES
BEDPLATES
ANGLE & FLAT BAR RINGS

C. & M. ENGINEERING CO. LTD.

THAMES Rd. BARKING, ESSEX
TELEPHONE: RIPpleway 3011-2

TWIN DISC

Clutches and Power Take-Offs
Single and three-stage Hydraulic Torque Converters.
Marine Reverse and Reduction Gears, Fluid Couplings.

BRITISH TWIN DISC LTD
PRIORY ROAD, STROOD, ROCHESTER, KENT
Telephone: STROOD 78661

McNEIL
manhole doors
for air-receivers,
boilers, etc.

HEAVY STEEL PRESSINGS
FOUNDRY LADLES
FABRICATED STEELWORK
WELDED CENTRAL
HEATING BOILERS

CHARLES McNEIL LIMITED
KINNING PARK HYDRAULIC FORGE
570 SCOTLAND STREET, GLASGOW, S.1.
Grams: "McNeil, Glasgow" Phone: South 1131

FOR SALE

VALES PLANT REGISTER LIMITED
OFFER FOR IMMEDIATE SALE

CRANES

NEALS 15-cwt. PORTABLE, 3 Jibs, Lister Diesel, Pneumatics, 1957–58. £600.
NEALS 1-ton "D" MOBILE, 30ft. Lattice, Ruston engine, pneumatics, 1950. £750.
JONES "Super 20" MOBILE, 16ft. Jib, Petrol, Solids. £275.
JONES "Super 22" MOBILE, 24ft. Jib, Pneumatics, with Grab. £650.
NEALS "NM" 2-ton MOBILE, 35ft. Jib, Ruston engine, Pneumatics. £1450.
COLES 2½-ton EMA MOBILE, 16ft. Jib, Perkins engine, Pneumatics. £1050.
ANDERSON GRICE 3-ton Electric DERRICK, 120ft. Jib, S.L.I. £1500.
JONES KL44 4-ton MOBILE, 40ft. Jib, Ruston diesel, Pneumatics, 1954. £2550.
ANDERSON GRICE 5-ton Electric DERRICK, 120ft. Jib, new 1946. £2600.
COLES THORNYCROFT 5-ton LORRY MOUNTED Mk. 7 series, 30ft. Jib, Rope derricking. £2500.
NEALS 4-6-ton "QM" MOBILE, Ruston engine, Pneumatics, 1953. £2500.
BUTTERS 5-ton Single Motor Electric DERRICK, 85ft. Jib. £1750.
COLES 6-ton MOBILE, 19ft. Jib, Pelapone engine, Pneumatics, new 1950.
BUTTERS 7-ton 2-motor Electric DERRICK, 120ft. Jib. £2975.
RUSHWORTH 70-ton Hand DERRICKS, 30ft. Lattice Jibs. £245 each.
MICHIGAN TMCT 16 74-ton LORRY MOUNTED, Crowd Shovel, Dragline and 30ft. Jib, Buda diesel, Pneumatics. £3300.
BUTTERS 10-ton Steam DERRICK, 120ft. with Bogies and Oil-fired Boiler.
COLES 12½-ton Fully MOBILE, 80ft. Jib. £4750.
FOR A COMPREHENSIVE LIST OF PLANT FOR SALE AND HIRE—SEND FOR VALES FREE PLANT REGISTER.

Further details:
14, Lower Grosvenor Place, London, S.W.1.
Telephone: VICtoria 7531, 3501, 8080, 9886 (15 lines). E107 G

FOR SALE

RAILWAY TURNTABLE
For Sale.—Mundt type standard gauge turntable, 65ft. long, carrying capacity 150 tons approx.
WATER CRANE
3000 gallon water crane.
TURNOUTS
Twenty 1 in 8 turnouts in 75 lb. F.B. rail; interchangeable to suit L.H. or R.H.
All these items are in excellent condition.

Apply: EAGRE CONSTRUCTION CO., LTD. East Common Lane, Scunthorpe, Lincs. ('Phone: 4513). E150 G

FOR SALE

NEWALL GRINDING MACHINES

Newall 10in. by 48in. Type LA Heavy Duty Hydraulic Cylindrical Grinding Machines; main motor 20 h.p.; takes grinding wheel 36in. diameter by 10in. face. 1951 machines in first-class condition.

F. J. EDWARDS LTD.,
359–361, EUSTON ROAD,
LONDON, N.W.1.
EUSton 4681 and 3771.
E6019 G

NISSEN TYPE HUTS for sale. Prompt despatch of 16ft., 24ft. and 30ft. wide huts; also "Romney" Huts, 35ft. wide, and "Blister" Hangars, 86ft. 6in. and 91ft. wide. These buildings are in various lengths and comprise steel framework with galvanised corrugated steel sheeting.—Full details from Dept. 115, J. Thorn and Sons, Ltd., Brampton Road, Bexleyheath, Kent (Tel.: Bexleyheath 3055). E113 G

When getting down to it—
remember
WARDS
might have it!

THOS. W. WARD LTD
ALBION WORKS, SHEFFIELD.

FOR SALE

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June 19	**Miscellaneous stores,** including hutting, timber, greatcoats, machine tools, etc.	Returned Stores Group, **Reed Hall, Colchester, Essex.**	**FENN, WRIGHT & CO.** (Dept. L), 146, High Street, Colchester, Essex. (Tel.: 3171.)
June 25–26	**Machine tools and miscellaneous stores**	Hawker Aircraft Factory, **South Shore, Blackpool.**	**LESLIE A. BUTSON** (Dept. L), 16, Birley Street, Blackpool. (Tel.: 21073.)
June 30–July 3	**Machine tools and miscellaneous stores.**	**M.O.S. Storage Depot, Royal Arsenal, Woolwich, S.E.18**	**FULLER, HORSEY, SONS & CASSELL** (Dept. L), 10, Lloyd's Avenue, E.C.3. (Tel.: Royal 4861.)
July 14–15	**Vehicles, M.T. spares and miscellaneous stores.**	**Central Ordnance Depot, Bicester, Oxon**	**MIDLAND MARTS, LTD.** (Dept. L), Market Square, Bicester, Oxon. (Tel.: 73.)
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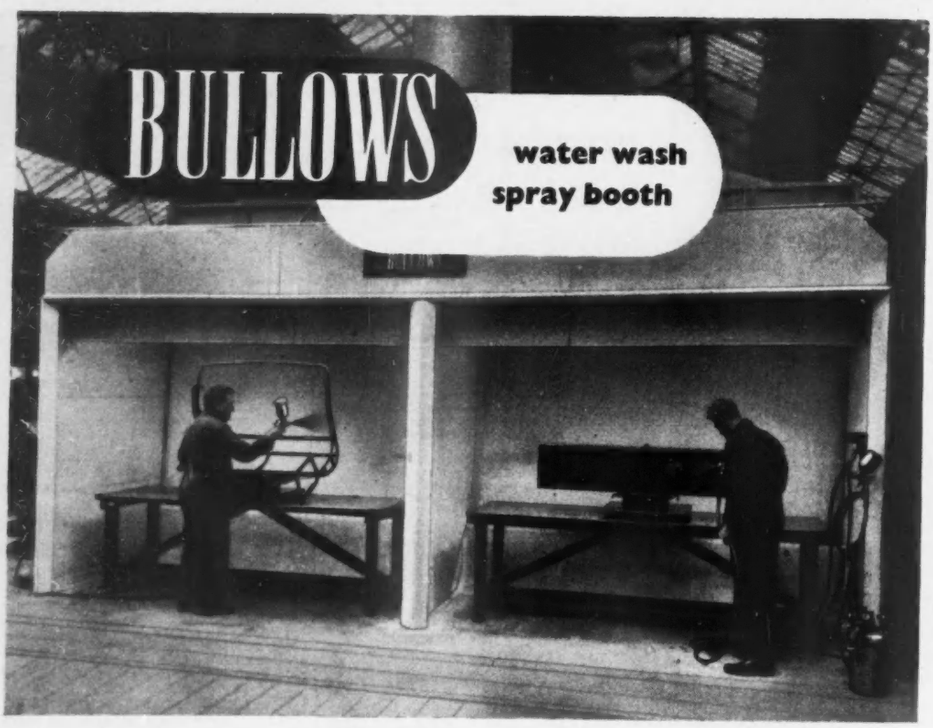

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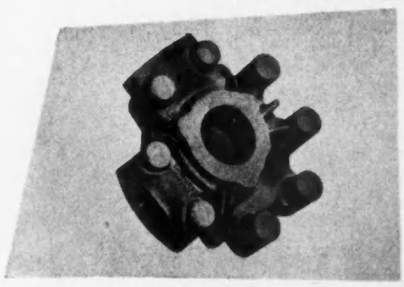

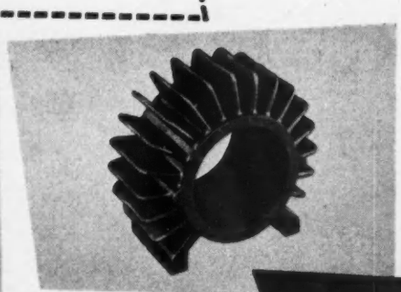

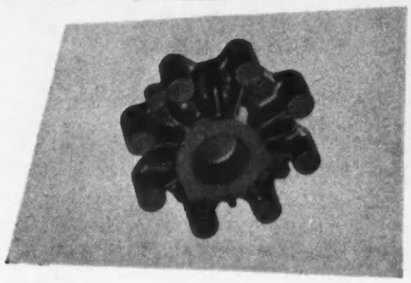

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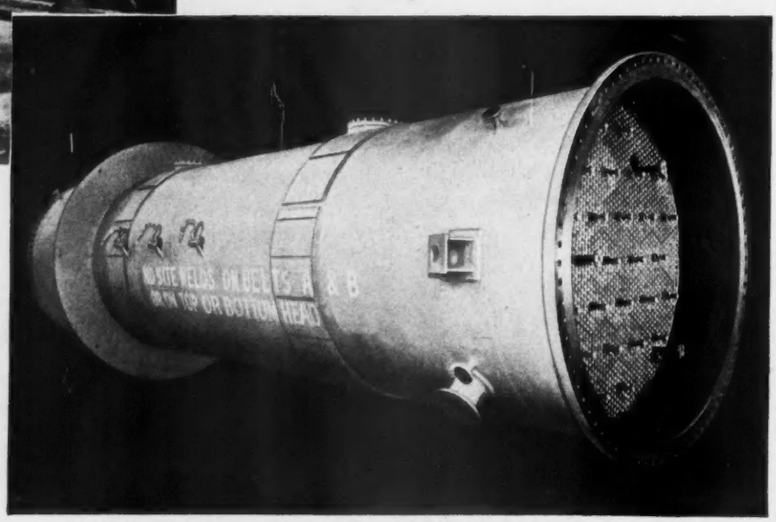

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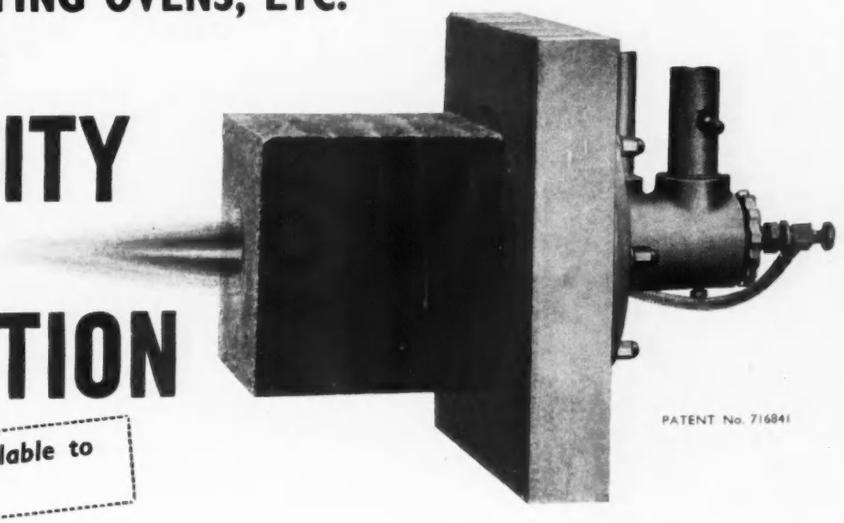

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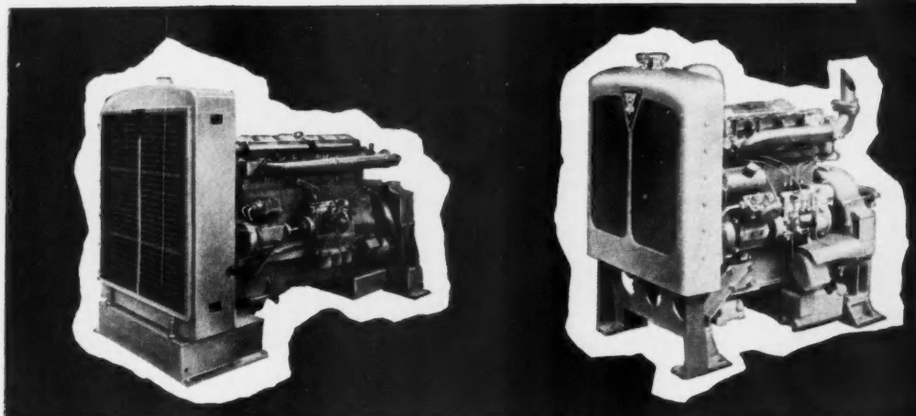

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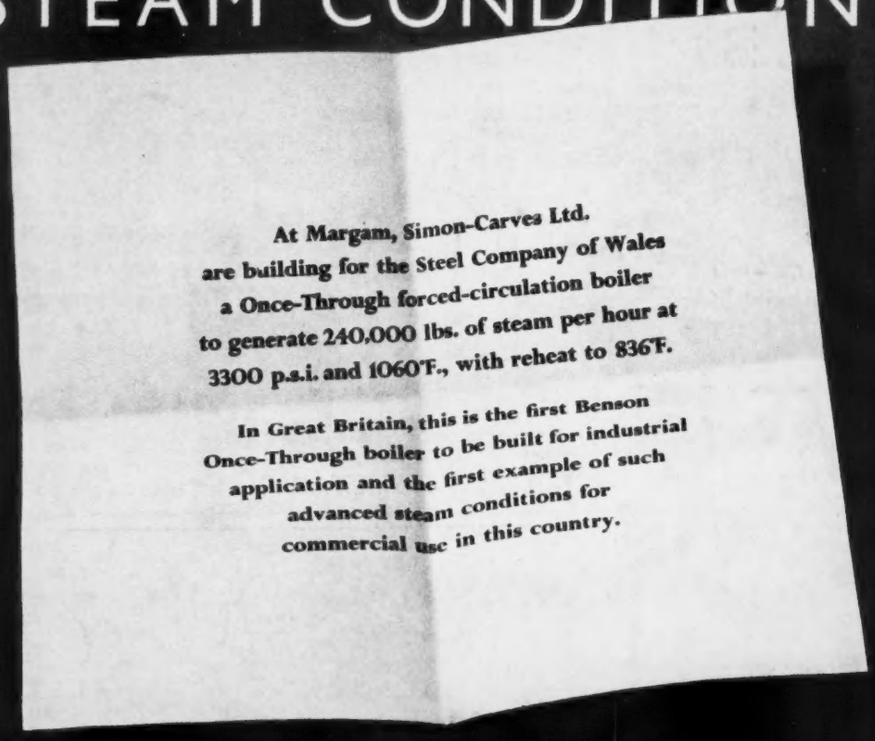

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